

Pallid Sturgeon Population Assessment and Associated Fish Community Monitoring for the Missouri River: Segment 9



Prepared for the U.S. Army Corps of Engineers – Missouri River Recovery Program

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EXECUTIVE SUMMARY

The Nebraska Game and Parks Commission (NGPC) in cooperation with the U.S. Army Corps of Engineers began sampling segment 9 in 2003. Segment 9 begins at the confluence of the Platte and Missouri Rivers (River Mile (R.M.) 595.0) at Plattsmouth, NE and continues downstream to the confluence of the Kansas and Missouri Rivers (R.M. 367.5) at Kansas City, MO. NGPC and the Missouri Department of Conservation (MDC) divided the sampling responsibilities for this segment.

The sturgeon season started on 26 October 2005 when water temperatures fell below 12.7°C and continued until 30 June 2006. During the sturgeon season, a total of nine hundred and fifty-five samples were completed using gill nets, otter trawls, 1.0" trammel nets and 2.5" trammel nets. The fish community season started 1 July 2006 and continued until 11 October 2006 when water temperature fell below 12.7°C. During the fish community season, a total of five hundred and eighty-seven samples were completed using otter trawls, 1.0" trammel nets and mini-fyke nets.

A total of 31 pallid sturgeon *Scaphirynchus albus* were captured during the 2006 sampling season. Hatchery reared pallid sturgeon recaptures accounted for twenty-two collections while the remaining nine are of unknown origin. Since the project's origination, hatchery reared pallid sturgeon had an 85% retention rate on PIT tags and have represented seven year classes (1997, 1999, 2001, 2002, 2003, 2004 and 2005) that have been stocked into RPMA #4. The only year classes that have been stocked but not sampled are 1992 and 2006. Standardized gears (gill nets (N = 15), trammel nets (N = 11) and otter trawls (N = 4)) collected thirty of the thirty-one pallid sturgeon during 2006. The remaining pallid sturgeon was collected using an experimental 4-mm mesh otter trawl. Mini-fyke nets and 2.5" trammel nets did not collect any pallid sturgeon. No young-of-the-year pallid sturgeon were collected with any gear during 2006.

Mean relative condition of hatchery reared pallid sturgeon was 1.05 at time of stocking but had declined to 0.82 when recaptured. Mean growth per day of stocked fish was 0.16 mm. Pallid sturgeon captures were distributed along the entire length of segment 9. Seven recaptures came from Upper Plattsmouth Bend (R.M. 595.0) and five from Lower Brownville Bend (R.M. 533.5). Upper Plattsmouth Bend is a historic "hot spot" because of the confluence of the Platte

and Missouri Rivers and the recent construction of Schilling Chute. Schilling Chute produced three pallid sturgeon. Most pallid sturgeon (N = 19) were captured on the inside bend channel borders. The ratio of pallid sturgeon to shovelnose sturgeon was 1:113 compared to 1:261 in 2005, 1:279 in 2004 and 1:1,076 in 2003. The decrease in this ratio can be attributed to the increased number of hatchery reared pallid sturgeon recaptured.

A total of 30,548 fish representing 69 species were captured during 2006 in segment 9. The Pallid Sturgeon Assessment Team identified eight native species to serve as target species to measure changes in the overall fish community. These target species include: shovelnose sturgeon *Scaphirhynchus platyrhynchus*, sturgeon chub *Macrhybopsis gelida*, sickfin chub *Macrhybopsis meeki*, speckled chub *Macrhybopsis aestivalis*, sand shiners *Notropis stramineus*, *Hybognathus* species (western silvery minnow *H. argyritis*, brassy minnow *H. hankinsoni* and plains minnow *H. placitus*), blue sucker *Cycleptus elongatus* and sauger *Sander canadense*. A total of 3,489 shovelnose sturgeon were sampled during 2006 with 3,291 captured with standard gears. Standard gears during 2006 included; gill nets (N = 1,934), 1.0" trammel nets (N = 890), otter trawls (N = 403) and 2.5" trammel nets (N = 64). Otter trawling collected 113 of 115 sturgeon chubs, all of the sicklefin chubs and 346 of 348 speckled chubs throughout both seasons. Mini-fyke nets continue to collect the most sand shiners, collecting 98% (N = 1,336). A total of 59 *Hybognathus* species were captured in 2006, mini-fyke nets collected all but one. A total of 617 blue suckers were collected during 2006, 1.0" trammel nets and 2.5" trammel nets collected 49% and 21%, respectively. One hundred thirty-seven sauger were captured in 2006, most while winter gill netting.

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Introduction

The pallid sturgeon *Scaphirynchus albus* is native to the Missouri and Mississippi River systems, has evolved with and adapted to large river conditions. Due to population declines, pallid sturgeon were federally listed as endangered in 1990. Modification of the pallid sturgeon's habitat by human activities has blocked fish movement, destroyed or altered spawning areas, reduced food sources or ability to obtain food, altered water temperature, reduced turbidity, and changed the hydrograph (USFWS 1993). In response to obvious declines in population and lack of recruitment, the United States Fish and Wildlife Service developed the Biological Opinion on the Operation of the Missouri River Main System Reservoir System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project and Operation of the Kansas River Reservoir System (Bi-Op) in 2000. This report made recommendations to the U.S. Army Corp of Engineers (USACE) to modify flows of the Missouri River to a more natural regime, to increase pallid sturgeon propagation and augmentation efforts, and to assist and provide funding for a basin-wide pallid sturgeon assessment. In response to the Bi-Op, the USACE formed the Pallid Sturgeon Population Assessment Team with representatives from federal and state agencies and universities. The team developed standard operating procedures (SOP) for long-term pallid sturgeon and associated fish community assessment for the Missouri River. This included creating standard habitat definitions, selecting and describing standard sampling gears thought to be suitable for use in the Missouri River, creating sampling protocols for sampling fish and habitat parameters and developing standard data sheets and reporting procedures.

The 2006 sampling season extended from the 26 October 2005 through the 11 October 2006 and was divided into two seasons: The sturgeon season and the fish community season. The reason for a split in seasons was that during the sturgeon season, the capture of sturgeon was more efficient due to increased sturgeon movement and the ability to use gill nets, an effective gear for sampling sturgeon when water temperatures permit. The sturgeon season was defined as the period when water temperatures fell below 12.7° C (55° F) in the fall, until 30 June. While water temperatures were below 12.7° C, experimental gill nets were used, and above this temperature, three additional gears were fished: 1.0" trammel nets, 2.5"

trammel nets, and otter trawls. Sampling was on the bend level with all bends being randomly selected and a minimum of eight sub-samples per bend.

The fish community season began 1 July and continued until water temperatures dropped below 12.7° C in the fall. Three gear types were used during the fish community season: 1.0” trammel nets, otter trawls, and mini-fyke nets. Sampling was on the bend level with all bends being randomly selected and a minimum of eight sub-samples per bend. The fish community season is the best time to identify natural reproduction of pallid sturgeon and other native target species. Because sturgeon are less active and gill nets can not be used because of temperature restrictions, efforts focus on sampling the associated fish community, including chubs and minnows, which are more readily sampled during this time. The Pallid Sturgeon Assessment Team selected 8 target species that represent the native warm water benthic fish community (Appendix A). The eight target species are: shovelnose sturgeon *Scaphirhynchus platyrhynchus*, blue sucker *Cycleptus elongatus*, sauger *Stizostedion canadense*, sturgeon chub *Macrhybopsis gelida*, sicklefin chub *Macrhybopsis meeki*, speckled chub *Macrhybopsis aestivalis*, *Hybognathus* species (western silvery minnow *H. argyritis*, brassy minnow *H. hankinsoni* and plains minnow *H. placitus*), and sand shiner *Notropis stramineus*. During the fish community season, these native species including pallid sturgeon are targeted.

The objectives and measurable hypotheses for the Pallid Sturgeon Population Assessment Team are as follows:

Objective 1. Document annual results and long-term trends in pallid sturgeon population abundance and geographic distribution throughout the Missouri River System.

- 1.1. H₀: Annual trends in wild and stocked pallid sturgeon population abundance for all life stages remains constant over time.
H_a: Annual trends in wild and stocked pallid sturgeon population abundance for all life stages increase or decrease over time.
- 1.2 H₀: Annual trends in wild and stocked pallid sturgeon geographic distribution for all life stages remain constant over time
H_a: Annual trends in wild and stocked pallid sturgeon geographic distribution for all life stages increase or decrease over time.

- 1.3 H₀: Long-term trends in wild and stocked pallid sturgeon population abundance for all life stages remains constant over time.
H_a: Long-term trends in wild and stocked pallid sturgeon population abundance for all life stages increase or decrease over time.
- 1.4 H₀: Long-term trends in wild and stocked pallid sturgeon geographic distribution for all life stages remains constant over time
H_a: Long-term trends in wild and stocked pallid sturgeon geographic distribution for all life stages increases or decreases over time.

Objective 2. Document annual results and long-term trends of habitat usage of wild pallid sturgeon and hatchery stocked pallid sturgeon by season by life stage.

- 2.1 H₀: Stocked and wild pallid sturgeon use the same habitat during all life stages annually.
H_a: Stocked and wild pallid sturgeon do not use the same habitat during all life stages annually.
- 2.2 H₀: Stocked and wild pallid sturgeon use the same habitat during all life stages over the long term.
H_a: Stocked and wild pallid sturgeon do not use the same habitat during all life stages over the long term.

Objective 3. Document the population structure and dynamics of pallid sturgeon in the Missouri River system.

- 3.1 H₀: The population structure of stocked and wild pallid sturgeon remains constant over time.
H_a: The population structure of stocked and wild pallid sturgeon changes over time.
- 3.2 H₀: The population dynamics of stocked and wild pallid sturgeon remain constant over time.
H_a: The population dynamics of stocked and wild pallid sturgeon change over time.

Objective 4. Document annual results and long-term trends in native target species population abundance and geographic distribution throughout the Missouri River System.

- 4.1 H₀: Annual trends in native target species abundance are stable throughout the year.
H_a: Annual trends in native target species abundance increase or decrease throughout the year.
- 4.2 H₀: Annual trends in native target species geographic distribution remains stable throughout the year.
H_a: Annual trends in native target species geographic distribution increases or decreases throughout the year.

- 4.3 H₀: Long-term trends in native target species population abundance are stable over time.
H_a: Long-term trends in native target species population abundance increases or decreases over time.
- 4.4 H₀: Long-term trends in the native target species geographic distribution remain constant over time.
H_a: Long-term trends in the native target species geographic distribution increases or decreases over time.

Objective 5. Document annual results and long-term trends of habitat usage of the native target species by season and life stage.

- 5.1 H₀: Native target species use the same habitat during all life stages annually.
H_a: Native target species do not use the same habitat during all life stages annually.
- 5.2 H₀: Native target species use the same habitat during all life stages over the long term.
H_a: Native target species do not use the same habitat during all life stages over the long term.

Objective 6. Document annual results and long-term trends of all non-target species population abundance and geographic distribution throughout the Missouri River system, where sample size is greater than fifty individuals.

- 6.1 H₀: Annual trends in non-target species abundance are stable throughout the year.
H_a: Annual trends in non-target species abundance are increasing or decreasing throughout the year.
- 6.2 H₀: Annual trends in non-target species geographic distribution remains stable throughout the year.
H_a: Annual trends in non-target species geographic distribution increases or decreases throughout the year.
- 6.3 H₀: Long-term trends in non-target species population abundance are stable over time.
H_a: Long-term trends in non-target species population abundance increases or decreases over time.
- 6.4 H₀: Long-term trends in the non-target species geographic distribution remain constant over time.
H_a: Long term trends in the non-target species geographic distribution increases or decreases over time.

Study Area

The project area includes the Missouri River from Fort Peck Dam (R.M. 1771.5) to the confluence of the Missouri and Mississippi Rivers (R.M. 0.0) and the lower reach of the Kansas River from the Johnson County Weir (R.M. 15.4) to the confluence with the Missouri River (R.M. 0.0). The Biological Opinion divided the Missouri River into river and reservoir reaches and categorized these areas as high, moderate or low priority management areas. The areas which were given high priority designation by the Bi-Op for the pallid sturgeon include Segment Area 2 (Fort Peck Dam, Montana to the headwaters of Lake Sakakawea, North Dakota), Area 8 (Fort Randall Dam, South Dakota to the Mouth of the Niobrara River, Nebraska), and Areas 10 through 15 (Gavins Point Dam, Nebraska/South Dakota to the mouth of the Missouri River at St. Louis, MO).

The Pallid Sturgeon Population Assessment Team identified 14 river segments based on changes in physical attributes such as degrading or aggrading stream bed, flow fluctuation, natural hydrograph, stream gradient, geology, water temperature, turbidity, substrate, discrete habitat changes (tributary or tributary influence) and modifications (presence of restoration projects) (Drobish, editor 2006). There are also several areas sampled that were not designated as high priority areas in the Bi-Op. These are being sampled because of known pallid sturgeon use and include the Kansas River from Johnson County Weir to the mouth and Bi-Op Segment Area 9 (Niobrara River, Nebraska to the headwaters of Lewis and Clark Lake Nebraska/South Dakota).

The Nebraska Game and Parks Commission and Missouri Department of Conservation Pallid Sturgeon Population Assessment crews sampled Segment 9, R.M. 595.0 from the confluence of the Platte and Missouri Rivers at Plattsmouth, Nebraska, downstream to R.M. 367.5 to the mouth of the Kansas River (R.M. 367.5) at Kansas City, Missouri (Figure 1a).

Methods

Sampling was conducted in accordance with the current Standard Operating Procedures (Drobish, editor 2006) established by a panel of representatives from various state and federal agencies involved with pallid recovery on the Missouri River. Descriptions of these procedures are reported in the appropriate sections.

Sampling Site Selection and Habitat Description

Segment 9 is the longest segment (227.5 miles) in this study and consists of 80 bends (Figure 1a). Twenty-one bends were randomly selected to be sampled for sturgeon and fish community seasons. NGPC was responsible for the sampling effort on the top 6 bends while MDC sampled the remaining 15 bends.

The Pallid Sturgeon Assessment Team developed a standard set of habitat classifications for the Missouri River (Appendix B) to describe areas of sampling effort. These classifications are broken down in to three distinct levels with macrohabitats at the top. Each river bend contains three continuous macrohabitats: main channel outside bend (OSB), main channel inside bend (ISB) and main channel cross over (CHXO). Additional discrete macrohabitats have been identified that may not be present in every bend. These include: large tributary mouth (TRML), small tributary mouth (TRMS), tributary confluence (CONF), large secondary channel-connected (SCCL), small secondary channel-connected (SCCS), tributary (TRIB) and non-connected secondary channel (SCN). Mesohabitats have been established and defined to further classify areas within macrohabitats. Mesohabitat classifications include: bars (BARS), pools (POOL), channel borders (CHNB), thalweg (TLWG) and island tips (ITIP). Bars are sandbars or shallow bankline habitat at the area of terrestrial/aquatic interface, where water depth is less than 1.2 m deep. Pools are areas immediately downstream from sandbars, dikes, snag-piles or other obstructions that have formed a scour hole greater than 1.2 m deep. Channel borders lie along a bankline or sandbar area between the thalweg and the 1.2 m depth interval. Thalweg is the main channel between the channel borders and is the area of maximum depth. Island tips are the areas immediately downstream of a bar or island where two channels converge and water depth is greater than 1.2 m.

Sampling Gear

Sampling gear and methods were developed by the Pallid Sturgeon Assessment Team and described in Missouri River Standard Operating Procedures for Sampling and Data Collection, (Drobish, editor 2006). Standard gear types and methods used are as follows.

Gill Net

The standard gill net was a four panel experimental gill net 30.5 m (100 ft.) long with a height of 2.4 m (8 ft.). The standard gill net had four 7.6 m (25 ft.) panels consisting of

38.1 mm (1.5") (Panel 1), 50.8 mm (2.0") (Panel 2), 76.2 mm (3.0") (Panel 3), and 101.6 mm (4.0") (Panel 4) multifilament bar mesh. Twine size was #104 for the 38.1 mm and 50.8 mm panels and #139 for the 76.2 mm and 101.6 mm panels. The float line was a braided poly-foam core of 13 mm (1/2") diameter and the lead line was 7.1 mm (9/32") (22.7 kg/183 m). A double length gill net (61 m or 200 ft.) could be used and consisted of two standard gill nets attached together but counted as twice the effort. Panel numbering continued for 61 m nets, so the second 38.1 mm mesh was panel 5, the second 50.8 mm mesh was panel 6, the second 76.3 mm mesh was panel 7 and the second 101.6 mm mesh was panel 8. The first panel set (38.1 mm (Panel 1) or 101.6 mm mesh (Panel 4 or 8)) was selected randomly and recorded. Gill net samples were overnight sets with a maximum set time of 24 hours.

Otter Trawl

The standard otter trawl had a width of 4.9 m (16 ft.), height of 0.9 m (3 ft.), and length of 7.6 m (25 ft.). The trawl had an 6.35 mm (1/4") inner bar mesh and an 19 mm (0.75") outer bar mesh, with a cod-end opening of 406.4 mm (16"). Trawl doors made from 19.1 mm (3/4") marine plywood, measuring 762 mm (30") by 381 mm (15"), were used to keep the trawl deployed on the river bottom. Otter trawls were fished downstream with the length of the trawl dependent upon the size of the macrohabitat and mesohabitat being sampled. Otter trawl samples covered a minimum of 75 m (246 ft.) and a maximum of 300 m (984 ft.).

1.0" Trammel Net

The standard 1.0" trammel net had a length of 38.1m (125 ft.), with an inner mesh 2.4 m (8 ft.) deep and two outer walls 1.8 m (6 ft.) deep. The inner mesh was composed of #139 multifilament twine with a bar mesh size of 25.4 mm (1.0"). The outer walls were #9 multifilament twine with a bar mesh size of 203.2 mm (8.0"). The float line was a 12.7 mm (1/2") foam core and the lead line was 22.7 kg (50 lb.). Trammel nets were drifted a minimum of 75 m and a maximum of 300 m.

2.5" Trammel Net

The 2.5" trammel net had a length of 38.1m (125 ft.), with an inner mesh 2.4 m (8 ft.) deep and two outer walls 1.8 m (6 ft.) deep. The inner mesh was composed of #208 multifilament twine with a bar mesh size of 63.5 mm (2.5"). The outer walls were #9 multifilament twine with a bar mesh size of 304.8 mm (12.0"). The float line was a 12.7 mm

(1/2") foam core and the lead line was 22.7 kg (50 lb.). Trammel nets were drifted a minimum of 75 m and a maximum of 300 m.

Mini-Fyke Net

The standard mini-fyke net had two rectangular frames (1.2 m (4.0 ft.) by 0.6 m (2.0 ft.)) and two hoops (0.6 m (2.0 ft.)) made of oil tempered spring steel. A 4.5 m (15 ft.) by 0.6 m (2.0 ft.) lead was connected to the second rectangular frame. The mini-fyke net had 3 mm (1/8") ace mesh with a 29.5 kg (65lb.) lead core line. Mini-fyke net samples were overnight sets with a maximum set time of 24 hours.

1.0" Green Dyed Trammel Net

The non-standard or wild 1.0" green dyed trammel net was constructed of the exact specifications of the standard 1.0" trammel net, except the netting was dyed green. This net was used during the 2006 sampling season to experiment if netting color affected the catch rates in different turbidity levels.

4-mm Otter Trawl

The non-standard or wild 4-mm otter trawl was constructed of the exact specifications of the standard otter trawl, except the netting was 4-mm anchovy mesh. These nets were used during the 2006 fish community season in an attempt to collect additional information about young-of-the-year *Scaphirhynchus* species.

Data Collection and Analysis

Fish Data Collection

When a pallid sturgeon was sampled, morphometric measurements were recorded along with pictures, habitat parameters and all tagging information. If the pallid sturgeon had not been previously PIT tagged, a PIT tag was placed in accordance with the protocols. Other target species were measured to the nearest millimeter and weighed to the nearest gram. All non-target species collected were measured to nearest millimeter and released. An exception to this was during the community sampling season, when mini-fyke netting samples were preserved in 10% formalin and brought back to the lab for identification. Mini-fyke net samples were identified to species, stored in 70% alcohol and labeled by species by sample.

Associated Environmental Data

Habitat samples were collected at the site of every pallid sturgeon capture and were collected at 25% of the remaining sampling sites by macrohabitat and mesohabitat. The predetermined parameters for habitat sampling were GPS coordinates (latitude and longitude in decimal degrees), water depth (m), water velocity ((mps) at bottom, 0.2, and 0.8 of water column), water temperature (°C), turbidity (NTU) and a sediment profile (based on percent of gravel, sand and silt).

Genetic Validation

Collection methods, including the handling of pallid sturgeon, conformed with methods described in Biological Procedures and Protocol for Collecting, Tagging, Sampling, Holding, Culture, Transporting, and Data Recording for Researchers and Managers Handling Pallid Sturgeon (Krentz, 2005). Fin clips for DNA analysis were taken from pallid sturgeon and suspected hybrids and sent to William Ardren at the Abernathy Fish Technology Center for validation.

Analyses

All datasheets were checked and submitted to Yan Hong and staff of the Missouri Department of Conservation. Data was processed and analyzed using Microsoft Access and SAS statistical software (SAS Institute, Version 9.1). Figures were generated via SigmaPlot.

Catch per Unit Effort

All fish collections are reported as catch per unit effort (CPUE) with the associated standard error. Catch per unit effort for gill nets is reported as the number of fish per 100 feet gill net night. Catch per unit effort for otter trawls are reported as number of fish per 100 linear meters trawled. Catch per unit effort for trammel nets is reported as number of fish per 100 meters drifted. Catch per unit effort for mini-fyke nets are reported as number of fish per net night. Catch per unit effort was calculated for each subsample instead of overall catch per overall effort in order to get a measure of variance. These individual CPUEs are then averaged to get a total CPUE for an individual gear, bend or segment.

Mean annual CPUE data were checked for normality (PROC UNIVARIATE) using SAS (SAS Institute, Version 9.1). These data did not follow a normal distribution and were then log₁₀ transformed. Normality assumptions were still not met. Therefore, to compare mean annual CPUE's between years, non-parametric statistical analysis were completed.

PROC GENMOD used a TYPE3 POISSON distribution to test for an overall difference amongst all years. For the model, PROC GENMOD prints the source data (i.e. Year), the degrees of freedom associated with the source, an F value statistic with associated p-value and a chi-squared statistic with associated p-value for testing the significance of the source to the model. When overall CPUE data were significantly different, PROC GENMOD ESTIMATE statement compared individual years. This determined which years were statistically different by comparing one years data versus a different years data. For the model, PROC GENMOD prints a label for the data (i.e. 2003 VS 2004), the estimated value, the standard error of the estimated value, upper and lower confidence limits and a chi-squared statistic with associated p-value for testing the significance of the model. Finally, CPUE by year was tested used PROC GENMOD to determine if there was a significant linear regression. For the model, PROC GENMOD prints the source data (i.e. Year), the degrees of freedom associated with the source and a chi-squared statistic with associated p-value for testing the significance of the source to the model. Significance was determined at $\alpha = 0.05$ for all test.

To determine if fish were being caught proportionately to where sampling effort was being conducted in each habitat type, a chi-squared analysis was performed using SAS (SAS Institute, Version 9.1).

Character Index

Pallid sturgeon, shovelnose sturgeon and hybrids can be distinguished using meristic and morphometric characteristics. Sheehan et al. (1999) developed the character index (CI) using two meristics (dorsal and anal fin ray counts) and five morphometric ratios. This equation categorized *Scaphirhynchus* specimens into three categories. Character index values for pallid sturgeon range from -1.48 to -0.09, hybrid sturgeon from -0.45 to 0.51 and shovelnose sturgeon from 0.37 to 1.33.

Relative Condition

The relative condition of recaptured hatchery reared pallid sturgeon was calculated using the formula:

$$Kn = (W / W');$$

where W is weight of the individual and W' is the length-specific mean weight predicted by the weight-length equation calculated for that population. Keenlyne and Evanson (1993) provided a weight-length regression:

$$\log_{10}W = -6.378 + 3.357 \log_{10}L (r^2 = 0.9740);$$

for pallid sturgeon throughout its range which was used to calculate a relative condition factor.

Relative Weight

The relative weight of shovelnose sturgeon was calculated using the formula:

$$Wr = 100 * (W / Ws);$$

where W is weight of the individual and Ws is the length-specific standard weight value for the species. Quist et al. (1998) provided a relative weight equation

$$\log_{10}W = -6.287 + 3.330 \log_{10}FL;$$

for shovelnose sturgeon throughout its range to calculate relative weight.

Relative Stock Densities

A length frequency indexes can be used to indicate changes in a population structure. Length categories were based on the percentage of the largest known pallid sturgeon are as followed (Gablehouse 1984): sub-stock fork length < 330 mm (20%), stock fork length = 330 – 629 mm (20 – 36%), quality fork length = 630 – 839 mm (36 - 45%), preferred fork length = 840 – 1039 mm (45 – 59%), memorable fork length = 1040 – 1269 mm (59 – 74%) and trophy fork length > 1270 mm (> 74%). Length categories based on the percentage of the largest known shovelnose sturgeon are as follows: sub-stock fork length < 250 mm (20%), stock fork length = 250 – 379 mm (20 – 36%), quality fork length = 380 – 509 mm (36 - 45%), preferred fork length = 510 – 639 mm (45 – 59%), memorable fork length = 640 – 809 mm (59 – 74%) and trophy fork length > 810 mm (> 74%). Proportional Stock Density (PSD) is proportion of fish of quality size in a stock. Relative Stock Density (RSD) is the proportion of fish of a size group in a stock. In order to determine if gears were collecting a different size range of fish between season, length frequency distributions for each species for each season were compared with a Kolmogorov-Smirnov test (SAS Institute, Version 9.1).

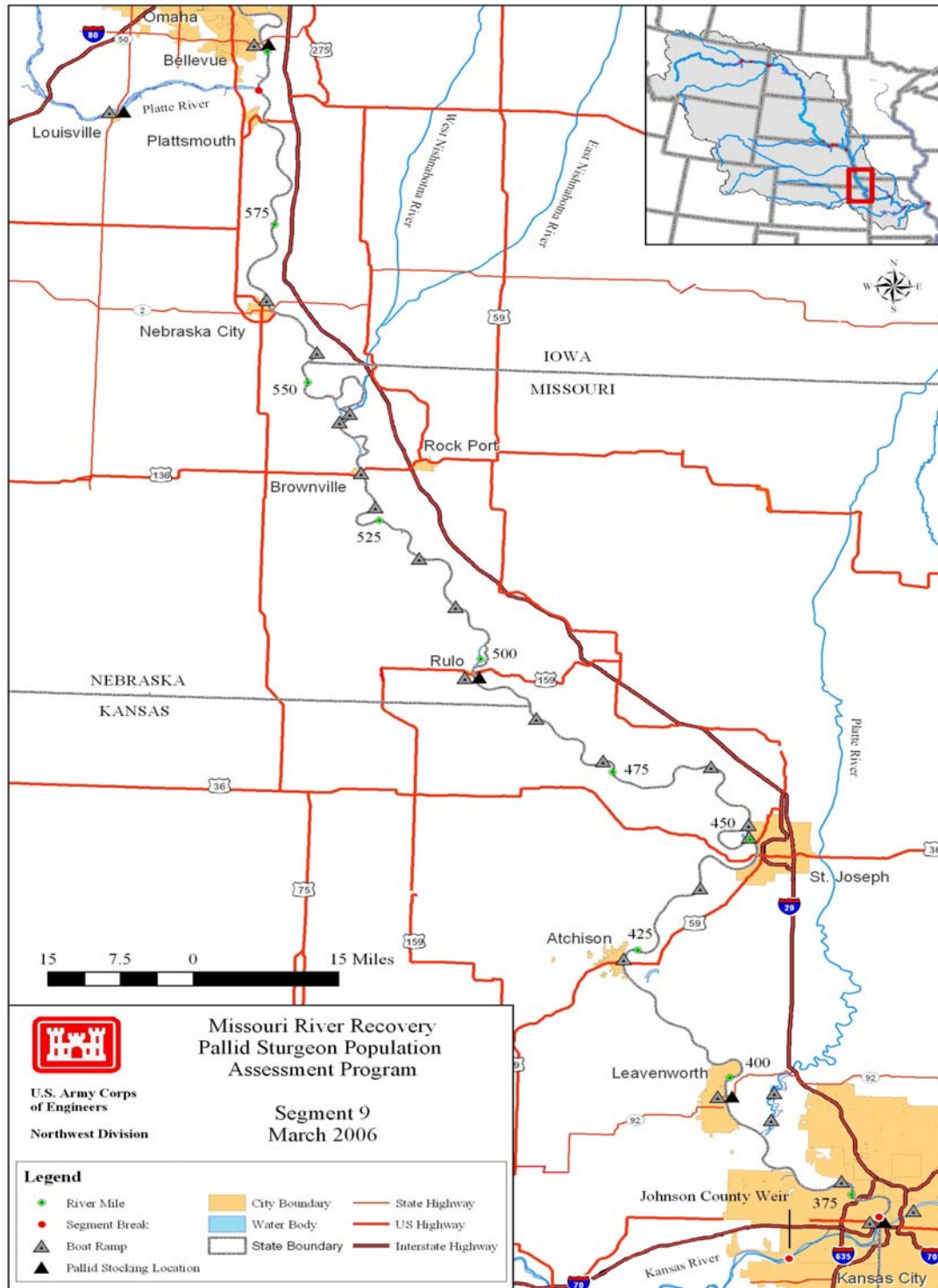


Figure 1a. Map of segment 9 of the Missouri River with major tributaries, common landmarks, and historic stocking locations for pallid sturgeon. Segment 9 encompasses the Missouri River from the Platte River (River Mile 595.0) to the Kansas River (River Mile 367.5).

Results

Effort

Sampling efforts in segment 9 is limited to a few macro and mesohabitats due to the simplification of the river due to channelization. Sampling was conducted primarily in bar, pool and channel border mesohabitats within inside bend and channel cross-over macrohabitats. The 100' and 200' standard gill nets have been used since this project started in March of 2003 and were only used during the sturgeon season due to temperature restrictions (Appendix C). Gill nets were set on the channel border and pool mesohabitats within the outside bend, inside bend, channel cross-over, secondary connected channel large and confluence macrohabitats (Tables 1 and 2). A total of 577 net nights of effort were expended with gill nets in segment 9 during 2006.

The standard 16' otter trawl has been used since this project started in 2003 and was used during the sturgeon season and the fish community season (Appendix C). Otter trawls were used to sample the channel border mesohabitats within the inside bend, channel cross-over, tributary mouth large, outside bend, secondary connected channel large and confluence macrohabitats (Tables 1 and 2). A total of 408 otter trawl samples were collected in segment 9 during 2006. Effort for the sturgeon season was the equivalent of 247.8 one hundred meter trawl deployments compared to 371.7 for the fish community season.

The standard 1.0" trammel nets have been used since this project started in 2003 and were used during the sturgeon season and the fish community season (Appendix C). One inch trammel nets were used to sample the channel border mesohabitats within the inside bend, channel cross-over, secondary connected channel large and confluence macrohabitats (Tables 1 and 2). A total of 443 trammel net drifts were conducted in segment 9 during 2006. Effort for the sturgeon season was the equivalent of 279.3 one hundred meter trammel net deployments compared to 207.9 for the fish community season.

The 2.5" trammel nets were used for sampling during the sturgeon season (Appendix C). This gear was developed prior to the 2005 sampling season to increase catch of larger fish, particularly adult pallid sturgeon. These trammel nets were used to sample the channel border mesohabitats within the inside bend, channel cross-over, confluence and secondary connected channel large macrohabitats (Tables 1 and 2). A total of 194 trammel net drifts

were conducted in segment 9 during 2006, resulting in an effort of 195.3 one hundred meter trammel net deployments.

The standard mini-fyke net has been used since this project started in 2003 and was used during the fish community season (Appendix C). Mini-fyke nets were used to sample the bar mesohabitats within the inside bend, channel cross-over, tributary mouth large, confluence and secondary connected channel large macrohabitats (Tables 1 and 2). A total of 166 mini-fyke sets were completed in segment 9 during 2006 resulting in an effort of 166 net nights.

Table 1. Number of bends sampled, mean effort per bend (total number of deployments), and total effort by macrohabitat for segment 9 on the Missouri River during fall through spring (sturgeon season) and summer (fish community season) in 2006. N-E indicates the habitat is non-existent in the segment.

Gear	Number of Bends	Mean Effort	Macrohabitat													
			BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Fall through Spring - Sturgeon Season																
1 Inch Trammel Net	21	13.3 (250)	N-E	51.7	9.8	N-E	N-E	172.6		45.0		N-E				
2.5 Inch Trammel Net	21	9.3 (194)		48.6	3.9			136.2		6.8						
Gill Net	28	20.6 (331)		136.0	4.0			410.0	17.0	10.0						
Otter Trawl	21	11.8 (180)		48.4	2.6			164.4	2.6	25.5				5.6		
Summer – Fish Community Season																
1 Inch Trammel Net	21	9.9 (193)	N-E	48.1	3.5	N-E	N-E	145.0		11.3		N-E				
Mini-Fyke Net	21	7.9 (166)		44.0				92.0	19.0	4.0				2.0	5.0	
Otter Trawl	21	17.7 (228)		71.9	8.9			244.6		37.9				8.4		

Table 2. Number of bends sampled, mean effort per bend (total number of deployments), and total effort by mesohabitat for segment 9 on the Missouri River during fall through spring (sturgeon season) and summer (fish community season) in 2006. N-E indicates the habitat is non-existent in the segment.

Gear	Number of bends	Mean Effort	Mesohabitat				
			BAR	POOL	CHNB	TLWG	ITIP
Fall through Spring – Sturgeon Season							
1 Inch Trammel Net	21	13.3 (250)			279.3		N-E
2.5 Inch Trammel Net	21	9.3 (194)			195.5		
Gill Net	28	20.6 (331)		240.0	337.0		
Otter Trawl	21	11.8 (180)			249.2		
Summer – Fish Community Season							
1 Inch Trammel Net	21	9.9 (193)			208.0		N-E
Mini-Fyke Net	21	7.9 (166)	166.0				
Otter Trawl	21	17.7 (228)			371.8		

Pallid Sturgeon

A total of 31 pallid sturgeon were sampled during 2006 with 30 captured in standard gears and one captured in a wild gear. Twenty-two of the fish were of known hatchery origin while nine were deemed of unknown origin because of the absence of tags or evidence of tagging scars. The sturgeon season was the most productive for pallid captures with twenty-seven fish sampled compared to four during the fish community season.

Pallid sturgeon were captured throughout segment 9 ranging from the confluence of the Platte and the Missouri Rivers (R.M. 595.0) downstream to Parkville Bend (R.M. 395.5) (Figure 1b). Seven pallid sturgeon were sampled from Upper Plattsmouth Bend (R.M. 595.0) followed by five pallid sturgeon from Lower Brownville Bend (R.M. 533.5) during the sturgeon and fish community seasons. Pallid sturgeon were collected from fifteen of the twenty-one randomly selected bends sampled.

Pallid sturgeon were captured from inside bend macrohabitats (N = 19) more frequently than any other macrohabitat sampled in segment 9 in 2006 (Table 3). Channel border and pool mesohabitats were the only mesohabitat where pallid sturgeon were collected. Channel borders accounted for twenty-one pallid sturgeon compared to ten collected in pools. The majority of pallid sturgeon were sampled in depths (97%), velocities (67%), temperatures (90%) and turbidities (80%) less than the average gear deployment (Table 3). However, due to low catch rates, preferred habitat parameters can not be determined.

Four (2001, 2002, 2003 and 2005) of the eight year classes that have been stocked into the upper reach of RPMA # 4 were represented in the 2006 hatchery reared pallid sturgeon recaptures (Table 6). The 1992, 1997, 2004 and 2006 year classes were not collected. Relative condition factor (Kn) for all year classes of hatchery reared pallid sturgeon have declined since stocking. However, all recaptured pallid sturgeon appeared healthy. Daily growth rates ranged from 0.10 mm per day for the 2002 year class to 0.23 mm per day for the 2003 year class. The 2005 year class was recaptured after being at large for an average of 60 days. This year class grew an average of 0.15 mm per day but declined in weight an average of -0.11 g per day.

The PSD value for all pallid sturgeon was only 18 during the sturgeon season compared to 100 during the fish community season but are based on very small sample sizes (Table 7). K_n was very similar by length category and season.

Segment 9 - Pallid Sturgeon Captures by River Mile

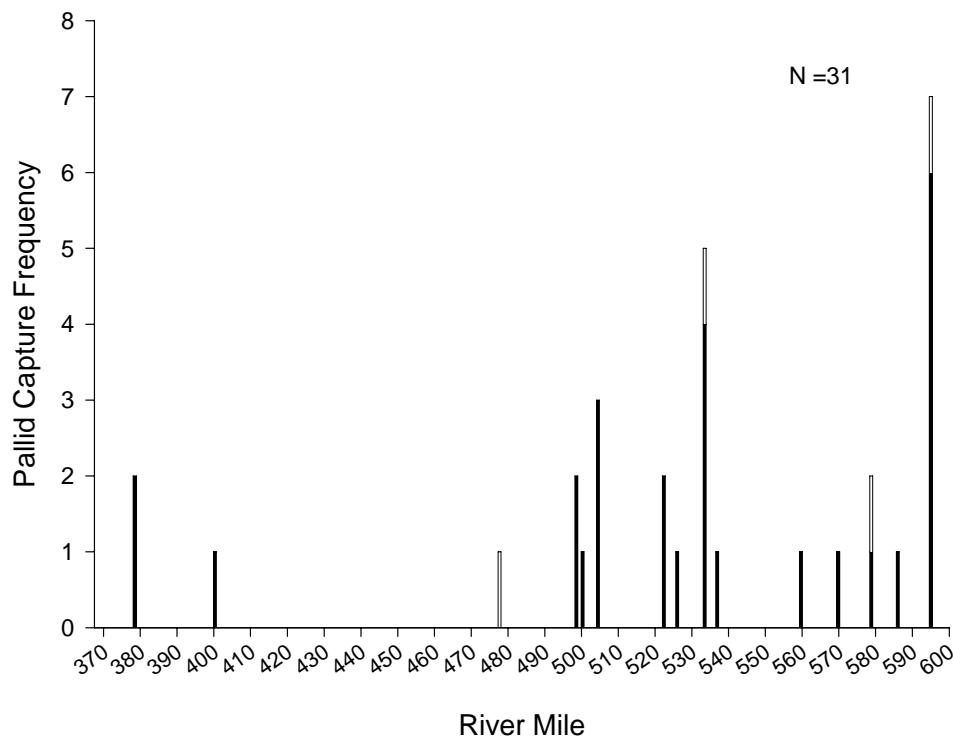


Figure 1b. Distribution of pallid sturgeon captures by river mile for segment 9 in randomly selected bends of the Missouri River during 2006. Black bars represent pallid captures during sturgeon season and white bars during fish community season.

Table 3. Pallid sturgeon (PDSG) capture summaries for all gears relative to habitat type and environmental variables on the Missouri River during 2006. Means (minimum and maximum) are presented. Habitat definitions and codes presented in Appendix B.

Macro-	Meso-	Depth (m) (Effort)	Depth (m) (Catch)	Bottom Velocity (m/s) (Effort)	Bottom Velocity (m/s) (Catch)	Temp. °C (Effort)	Temp. °C (Catch)	Turbidity (ntu) (Effort)	Turbidity (ntu) (Catch)	Total Pallids caught
CHXO	BARS	0.5 (0.3 – 0.7)		0.02 (0.00 – 0.08)		25.3 (16.0 – 30.0)		45 (22 – 121)		
	CHNB	2.8 (1.2 – 2.5)	2.6 (2.0 – 3.6)	0.70 (0.00 – 1.39)	0.42 (0.05 – 0.71)	18.1 (3.0 – 31.0)	9.6 (3.2 – 17.0)	103 (24 – 1792)	58 (34 – 115)	5
	POOL	2.6 (1.2 – 4.8)	1.4	0.29 (0.01 – 0.98)	0.14	6.8 (3.0 – 12.3)	6.0	67 (18 – 369)	56	1
CONF	CHNB	2.6 (1.4 – 5.3)	2.1	0.39 (0.01 – 1.05)	0.22	21.6 (9.9 – 26.3)	24.8	190 (33 – 1106)	1106	1
	POOL	1.5 (1.5 – 1.5)	1.5	0.17 (0.17 – 0.17)	0.17	10.8 (10.6 – 11.1)	11.1	35 (35 – 35)	36	1
ISB	BARS	0.5 (0.3 – 0.8)		0.62 (0.00 – 0.18)		25.5 (15.5 – 31.0)		46 (22 – 109)		
	CHNB	2.6 (1.1 – 7.1)	2.2 (1.2 – 2.5)	0.66 (0.03 – 1.82)	0.62 (0.30 – 1.23)	18.3 (3.0 – 31.0)	18.3 (7.8 – 28.5)	103 (24 – 1987)	87 (33 – 241)	11
	POOL	3.6 (1.2 – 9.6)	2.8 (1.2 – 4.1)	0.33 (0.00 – 1.10)	0.49 (0.19 – 0.87)	5.6 (3.0 – 12.1)	5.6 (4.0 – 7.0)	56 (21 – 362)	46 (36 – 68)	8
OSB	BARS	0.5 (0.4 – 0.7)		0.02 (0.00 – 0.13)		23.7 (16.0 – 34.0)		39 (28 – 60)		
	CHNB	3.3 (1.8 – 4.5)		0.36 (0.02 – 0.97)		6.5 (3.0 – 10.5)		145 (35 – 301)		
	POOL	3.4 (2.5 – 5.3)		0.18 (0.01 – 0.27)		6.2 (4.7 – 8.2)		53 (31 – 76)		
SCCL	BARS	0.5 (0.4 – 0.6)		0.05 (0.00 – 0.11)		24.6 (22.0 – 27.9)		62 (31 – 94)		
	CHNB	1.6 (0.8 – 4.0)	1.2	0.72 (0.20 – 1.13)	0.92 (0.85 – 0.99)	20.4 (8.2 – 29.8)	21.3 (14.3 – 26.6)	104 (26 – 405)	178 (64 – 405)	3
	POOL	3.7 (2.9 – 4.3)				9.1 (8.2 – 11.0)		216 (81 – 352)		
TRML	BARS	0.6 (0.5 – 0.7)		0.02 (0.02 – 0.02)		24.8 (24.8 – 24.8)		47 (47 – 47)		
	CHNB	1.5 (1.2 – 1.8)	1.6	0.65 (0.64 – 0.66)		23.7 (22.2 – 25.6)	23.3	85 (43 – 117)	90	1
TRMS	BARS	0.6 (0.5 – 0.7)		0.00 (0.00 – 0.00)		23.2 (16.5 – 28.0)		64 (29 – 100)		

Table 6. Mean fork length, weight, relative condition factor (Kn) and growth rates for hatchery-reared pallid sturgeon captures by year class at the time of stocking and recapture during 2006 from segment 9 of the Missouri River. Relative condition factor was calculated using the equation in Keenlyne and Evanson (1993). Standard error (+/- 2SE) was calculated where N>1 and is represented on second line of each year.

Year class	N	Stock Data			Recapture Data			Growth Data	
		Length (mm)	Weight (g)	Kn	Length (mm)	Weight (g)	Kn	Length (mm/d)	Weight (g/d)
2001	4	210			510	431	0.79	0.21	
		(8)			(82)	(169)	(0.09)	(0.06)	
2002	6	306	98	1.13	404	199	0.82	0.10	0.03
		(15)			(32)	(53)	(0.05)	(0.02)	
2003	2	271	75	1.23	419	207	0.77	0.23	0.21
		(38)	(11)	(0.39)	(2)	(6)	(0.01)	(0.06)	(0.01)
2005	7	271	63	0.98	279	60	0.86	0.15	- 0.11
		(26)	(16)	(0.05)	(27)	(18)	(0.11)	(0.07)	(0.19)

Table 7. Incremental relative stock density (RSD)^a and relative condition factor (Kn) for all pallid sturgeon captured with all gear by a length category during 2006 in the Missouri River. Length categories^b determined using the methods proposed by Shuman et al. (2006). Relative condition factor was calculated using the equation in Keenlyne and Evanson (1993).

Length Category	N	RSD	Kn (+/- 2SE)
Sturgeon Season			
Sub-stock (0-199)			
Sub-stock (200-329)	5		
Stock (330 – 629)	22		0.79 (0.03)
Quality (630 – 839)	4	18	0.80 (0.17)
Preferred (840- 1039)	2	9	0.81 (0.06)
Memorable (1,040 – 1,269)			
Trophy (> 1,270)			
Overall Kn			0.80 (0.03)
Fish Community Season			
Sub-stock (0-199)			
Sub-stock (200-329)	2		
Stock (330 – 629)	2		
Quality (630 – 839)	2	100	0.79
Preferred (840- 1039)	1	50	0.70
Memorable (1,040 – 1,269)			
Trophy (> 1,270)			
Overall Kn			0.75 (0.09)

^a RSD = (# of fish of a specified length class / # of fish \geq minimum stock length fish) * 100.

^b Length categories based on the percentage of the largest known pallid sturgeon: Sub-stock FL (20 %), Stock (20 – 36 %), Quality (36 – 45 %), Preferred (45 – 59 %), Memorable (59 – 74 %), Trophy (>74 %).

Year comparisons, Gear evaluation and Habitat associations

A total of 31 pallid sturgeon were captured in 2006 including 30 with standard gears. Standard gears during 2006 included: gill nets (N = 15), 1.0" trammel nets (N = 11), and otter trawls (N = 4). Non-standard or wild gear during 2006 included: 4-mm otter trawl (N = 1). During the 2006 sturgeon season, hatchery reared pallid sturgeon were captured in three of the four standard gears. One inch trammel nets produced the highest CPUE (0.019 fish per 100 m drifted), followed by otter trawls (CPUE = 0.016 fish per 100 m trawled) and gill nets (CPUE = 0.014 fish per net night) (Figures 2 and 3). Gill netting CPUE's for hatchery reared pallid sturgeon were statically different between years, 2003 and 2004 were significantly lower than 2006 ($\chi^2 = 5.49$, $P = 0.01$ and $\chi^2 = 5.07$, $P = 0.02$, respectively). No wild or unknown pallid sturgeon have been collected when otter trawling during the last three sturgeon seasons and no pallid sturgeon have been collected when drifting the 2.5" trammel nets.

During the 2006 fish community season only four pallid sturgeon were collected. All four were collected in one inch trammel nets, resulting in a CPUE of 0.006 fish per 100 m drifted for unknown pallid sturgeon and 0.013 fish per 100 m drifted for hatchery reared pallid sturgeon (Figure 5).

No sub-stock (0 – 199 mm) pallid sturgeon were collected during the 2006 sampling season. Five sub-stock (200 – 329 mm) pallid sturgeon were collected during the sturgeon season and two during the fish community season (Tables 11 and 12). Sub-stock (200 – 329 mm) pallid sturgeon were collected from inside bends (N = 4), secondary connected channel large (N = 2) and tributary confluences (N = 1) macrohabitats, and all were collected on channel border mesohabitats. Eighteen stock size (330 – 629 mm) pallid sturgeon were sampled during the 2006 sturgeon season (Tables 13 and 14). The majority (67%) of the stock size (330 – 629 mm) pallid sturgeon were collected on the inside bend with gill nets. However, 1.0" trammel nets in secondary channel connected large macrohabitats and otter trawls in channel cross-over macrohabitats produced fifty percent of the catch with only nineteen percent of the effort. Five quality and above size (> 630 mm) pallid sturgeon were sampled during 2006, with four being collected during the sturgeon sampling season (Tables 15 and 16). Eighty percent were sampled from inside bend macrohabitats compared to 20%

from channel cross-over macrohabitats. Two fish were sampled in pool mesohabitats and three were sampled in channel border mesohabitats during both seasons.

A total of 31 pallid sturgeon were measured during 2006, with 27 being sampled during the sturgeon season (Figure 8). The average fork length was 490 mm during the sturgeon season compared to 519 mm for the fish community season. The length range for pallid sturgeon sampled during the sturgeon season was 224 to 1,030 mm compared to 241 to 853 mm for the fish community season.

Since this project began, 60 pallid sturgeon have been collected and the number collected has increased each year. During the 2003 sampling season three fish were collected (Wild = 2 and Hatchery = 1), in 2004 eleven fish were collected (Wild = 6 and Hatchery = 5), in 2005 fifteen fish were collected (Wild = 5, Hatchery = 9 and Unknown = 1) and 31 fish were collected in 2006 (Wild = 5, Hatchery = 20 and Unknown = 6) (Figure 9).

Segment 9 - Pallid Sturgeon / Sturgeon Season

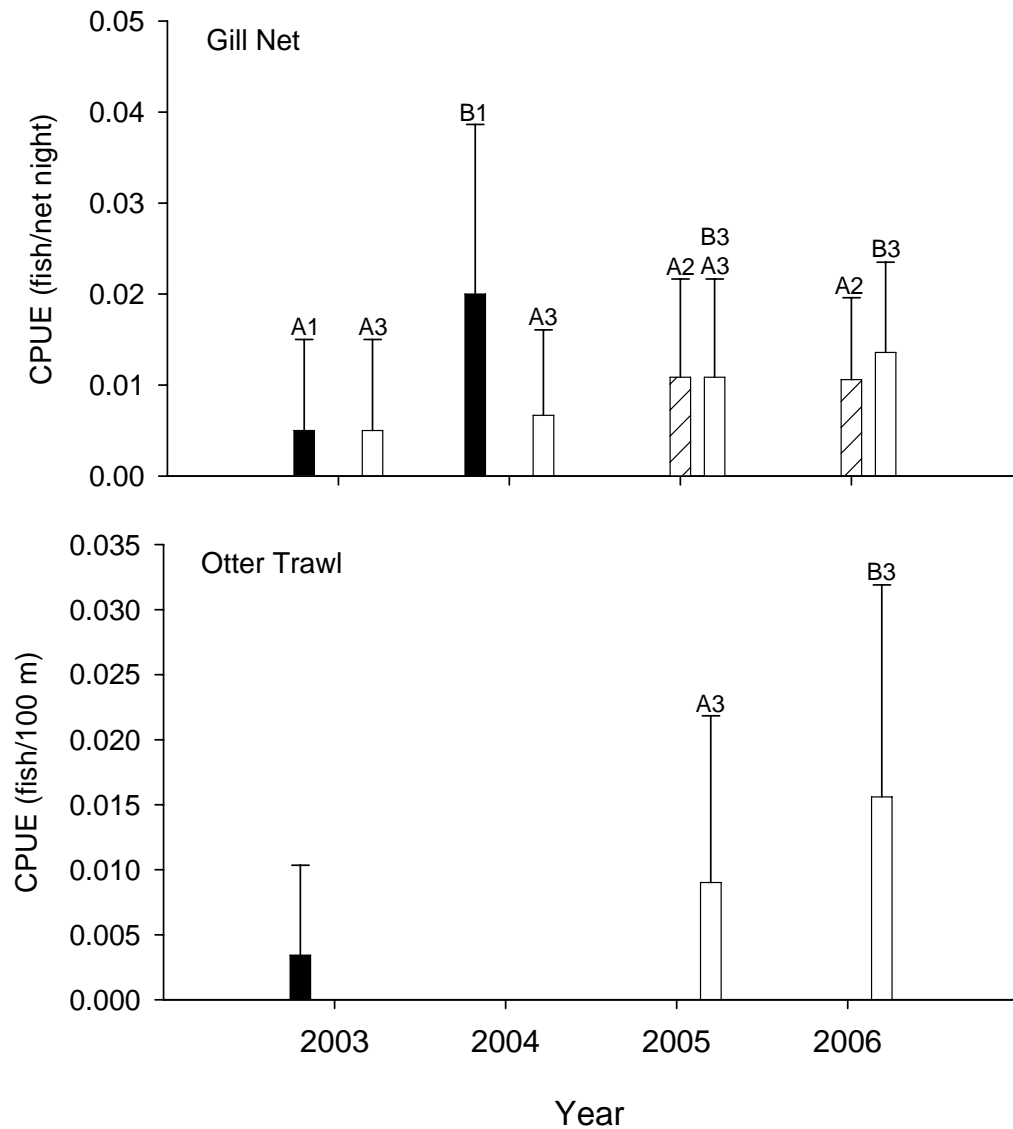


Figure 2. Mean annual catch-per-unit-effort (\pm 2 SE) of wild (black bars), unknown (cross-hatched) and hatchery reared (white bars) pallid sturgeon using gill nets and otter trawls in segment 9 of the Missouri River during sturgeon season 2003-2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Pallid Sturgeon / Sturgeon Season

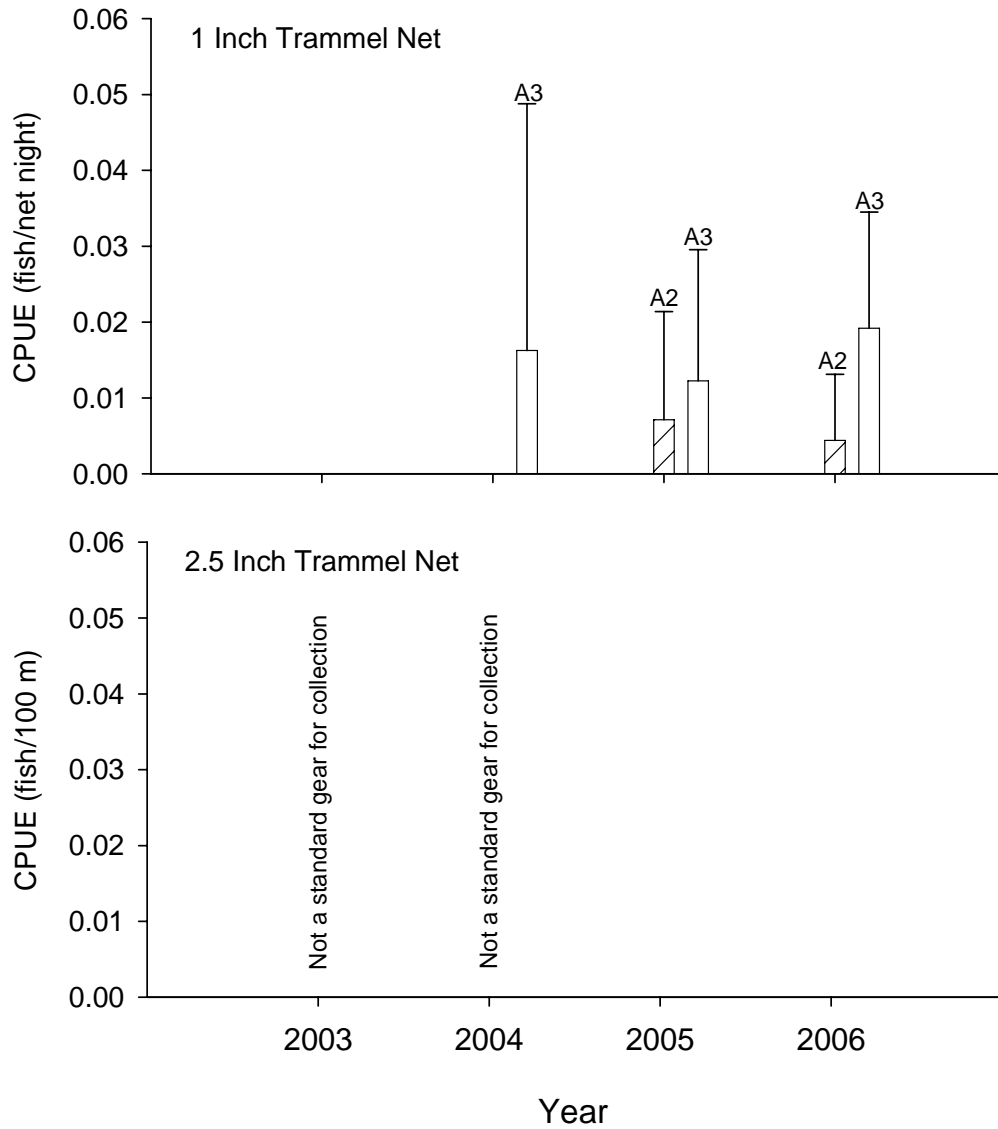


Figure 3. Mean annual catch-per-unit-effort (± 2 SE) of wild (black bars), unknown (cross-hatched) and hatchery reared (white bars) pallid sturgeon using 1 and 2.5 inch trammel nets in segment 9 of the Missouri River during sturgeon season 2003-2006. Letter denote a significant difference in yearly comparisons.

Segment 9 - Pallid Sturgeon / Fish Community Season

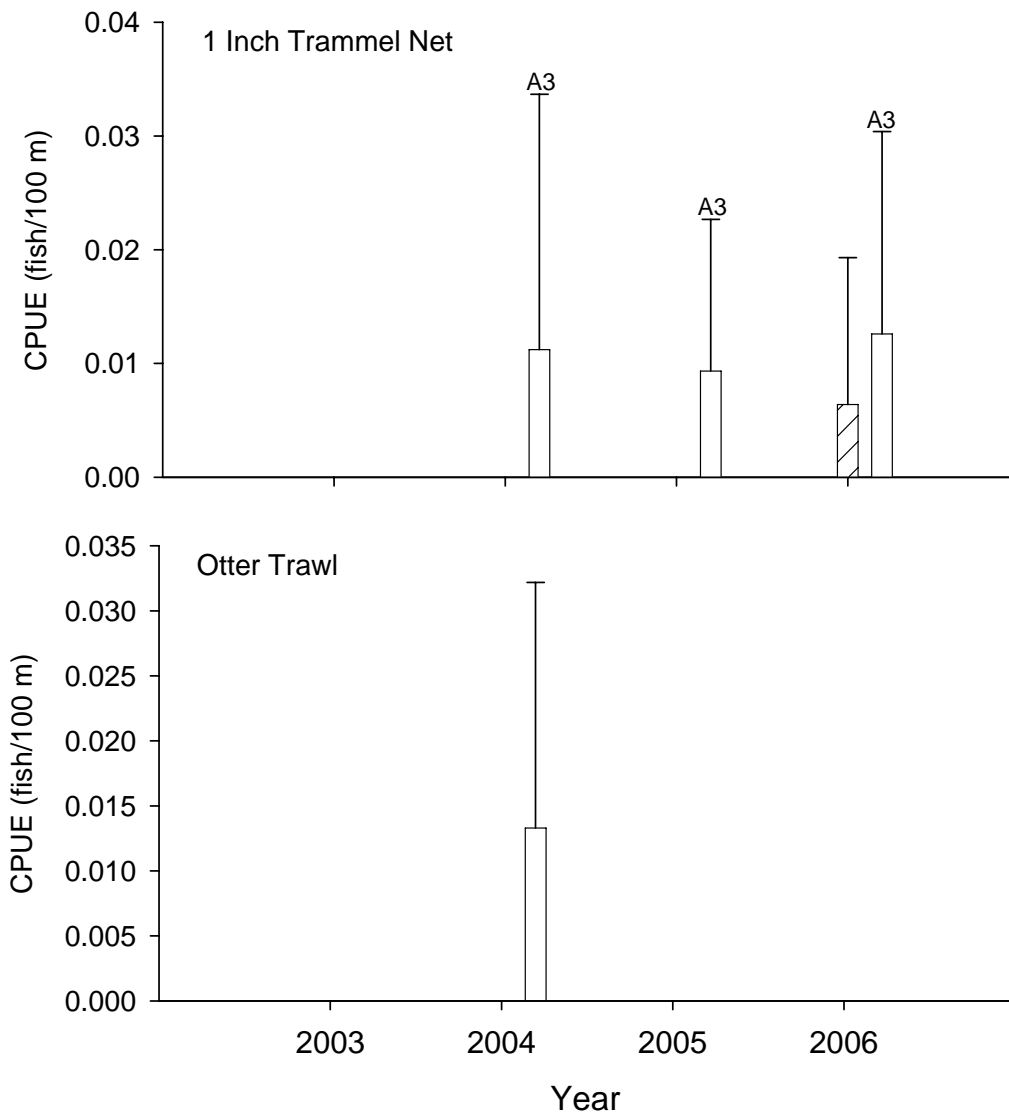


Figure 5. Mean annual catch-per-unit-effort (± 2 SE) of wild (black bars), unknown (cross-hatched) and hatchery reared (white bars) pallid sturgeon using 1 inch trammel nets and otter trawls in segment 9 of the Missouri River during fish community season 2003-2006. Letters denote a significant difference in yearly comparisons.

Table 11. Total number of sub-stock size (200-329 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	3	N-E	17	33 4	N-E	N-E	67 60		19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net			23	1			71	3	2						
Otter Trawl	2		19	1			65	1	50 11				50 3		
Fish Community Season (Summer)															
1 Inch Trammel Net	2	N-E	23	2	N-E	N-E	100 70		5		N-E				
Mini-Fyke Net			27				55	12	2				1	3	
Otter Trawl			19	2			66		10				2		

Table 12. Total number of sub-stock size (200-329 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	3		100 100	N-E		
2.5 Inch Trammel Net			100			
Gill Net			58		42	
Otter Trawl	2		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net	2		100 100	N-E		
Mini-Fyke Net		100				
Otter Trawl			100			

Table 13. Total number of stock size (330-629 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	4	N-E	17	4	N-E	N-E	50 60		50 19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net	12		25 23	8 1			67 71	3	2						
Otter Trawl	2		50 19	1			50 65	1	11				3		
Fish Community Season (Summer)															
1 Inch Trammel Net		N-E	23	2	N-E	N-E	70		5		N-E				
Mini-Fyke Net			27				55	12	2				1	3	
Otter Trawl			19	2			66		10				2		

Table 14. Total number of stock size (330-629 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	4		100 100	N-E		
2.5 Inch Trammel Net			100			
Gill Net	12		33 58		67 42	
Otter Trawl	2		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net			100	N-E		
Mini-Fyke Net		100				
Otter Trawl			100			

Table 15. Total number of quality size and greater (≥ 630 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	1	N-E	17	4	N-E	N-E	100 60		19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net	3		33 23	1			67 71	3	2						
Otter Trawl			19	1			65	1	11				3		
Fish Community Season (Summer)															
1 Inch Trammel Net	1	N-E	23	2	N-E	N-E	100 70		5		N-E				
Mini-Fyke Net			27				55	12	2				1	3	
Otter Trawl			19	2			66		10				2		

Table 16. Total number of quality size and greater (≥ 630 mm) pallid sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 7. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	1		100 100	N-E		
2.5 Inch Trammel Net			100			
Gill Net	3		33 58		67 42	
Otter Trawl			100			
Fish Community Season (Summer)						
1 Inch Trammel Net	1		100 100	N-E		
Mini-Fyke Net		100				
Otter Trawl			100			

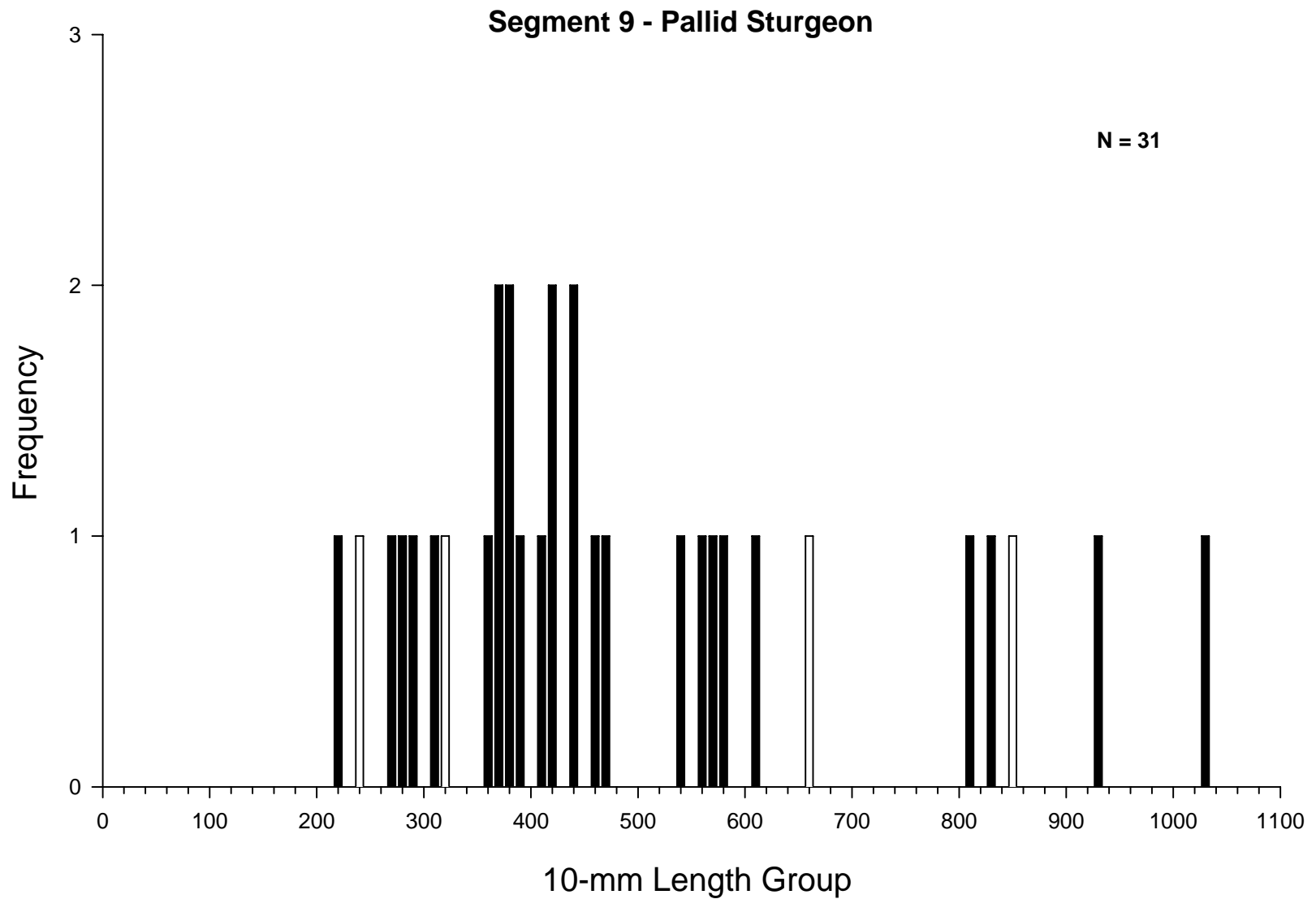


Figure 8. Length frequency of pallid sturgeon captured during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 9 of the Missouri River during 2005 - 2006 including non-random and wild samples.

Segment 9 - Annual Pallid Sturgeon Capture History

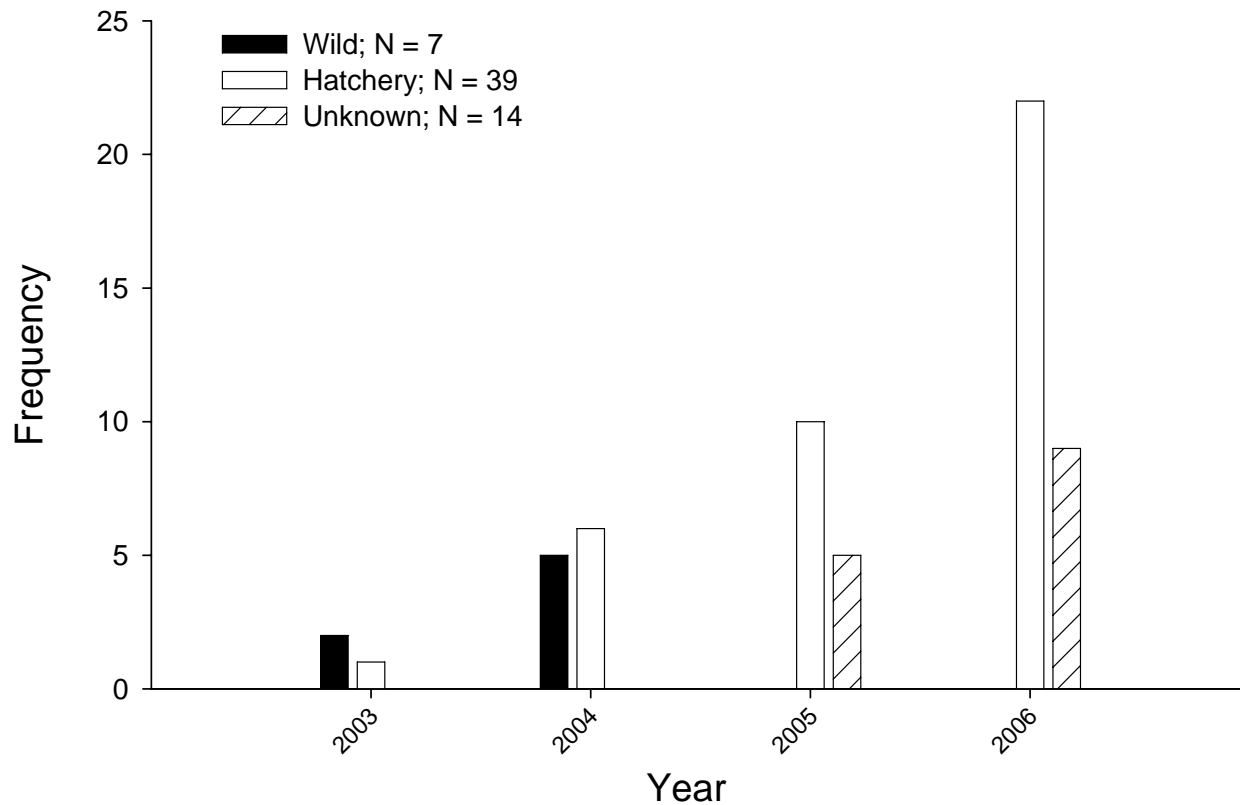


Figure 9. Annual capture history of wild (black bars), hatchery reared (white bars) and unknown (cross-hatched) pallid sturgeon collected in segment 9 of the Missouri River from 2003 to 2006. Figure is designed to compare overall pallid sturgeon captures from year to year and may be biased by variable effort between years.

Shovelnose X Pallid Sturgeon Hybrids

A total of thirteen hybrid sturgeon were collected during the 2006 sampling season and were determined hybrids using the Sheehan (1999) character index. All hybrid sturgeon were collected by the Missouri Department of Conservation in the lower reach of segment 9. This is an increase from three hybrid sturgeon during 2005. All hybrids were sampled on the inside bend macrohabitats. Gill nets collected twelve hybrid sturgeon and otter trawling collected the remaining one fish. The average fork length was 591 mm and average weight of 737 g.

Targeted Native River Species

Shovelnose Sturgeon

A total of 3,489 shovelnose sturgeon were sampled during 2006 with 3,291 captured with standard gears. Standard gears during 2006 included: gill nets (N = 1,934), 1.0" trammel nets (N = 890), otter trawls (N = 403) and 2.5" trammel nets (N = 64). Non-standard or wild gear included: 1.0" green dyed trammel nets (N = 102), 4-mm otter trawl (N = 75) and wild gill netting (N = 21). Gill nets remind the most effective gear during the sturgeon season (Figures 11 and 12). Numbers of sub-stock (0 – 149 and 150 – 249 mm) and stock (250 – 379) sized shovelnose sturgeon was low for all gears during the sturgeon season. Catch per unit effort of quality and above size (> 380 mm) shovelnose sturgeon for gill nets during the sturgeon season has continued on a significant downward trend ($\chi^2 = 794.68$, $df = 1$, $P = < 0.0001$). In 2003, CPUE was 11.7 fish per net night compared to 2004, 2005 and 2006 when CPUE declined to 7.3, 6.8 and 3.4 fish per net night, respectively. A significant decrease in mean annual CPUE from 2003 to 2005 ($\chi^2 = 6.11$, $P = 0.01$) was observed for quality and above (> 380 mm) size shovelnose sturgeon while otter trawling. However, during 2006, CPUE significantly increased from 2005 ($\chi^2 = 9.07$, $P = 0.002$). Catch per unit effort for one inch trammel nets during the sturgeon season for quality and above (> 380 mm) size shovelnose sturgeon have not changed since 2003 ($\chi^2 = 2.50$, $df = 3$, $P = 0.47$). The 2.5" trammel net remains an ineffective gear at collecting all size classes of shovelnose sturgeon.

No sub-stock (0 - 149 or 149 - 249 mm) shovelnose sturgeon were collected during the fish community season while trammel netting and the number of sub-stock (0 – 149 mm and 150 – 249 mm) and stock (250 – 379 mm) sized shovelnose sturgeon collected while otter trawling was low (Figure 14). Only 23 stock (250 – 379 mm) sized shovelnose sturgeon were captured using a 1.0" trammel nets during the fish community season, resulting in a CPUE of 0.08 fish per 100 m drifted. Quality and above size (> 380 mm) shovelnose sturgeon continue on a significant downward trend for 1.0" trammel nets ($\chi^2 = 46.97$, $P = < 0.0001$) and otter trawls ($\chi^2 = 13.82$, $P = 0.0002$) during the fish community season.

Segment 9 - Shovelnose Sturgeon / Sturgeon Season

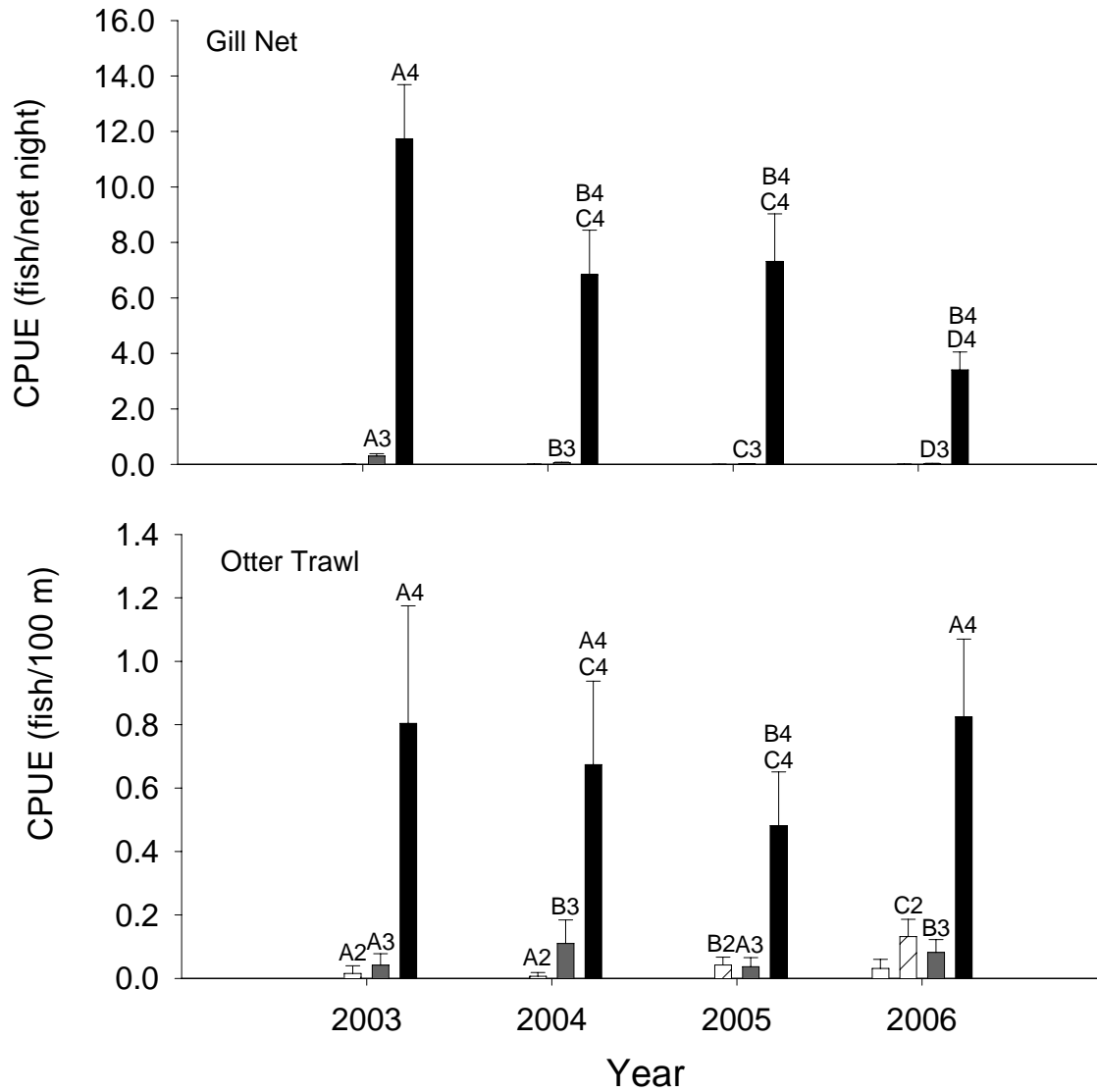


Figure 11. Mean annual catch-per-unit-effort (\pm 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon using gill nets and otter trawls in segment 9 of the Missouri River during sturgeon season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Shovelnose Sturgeon / Sturgeon Season

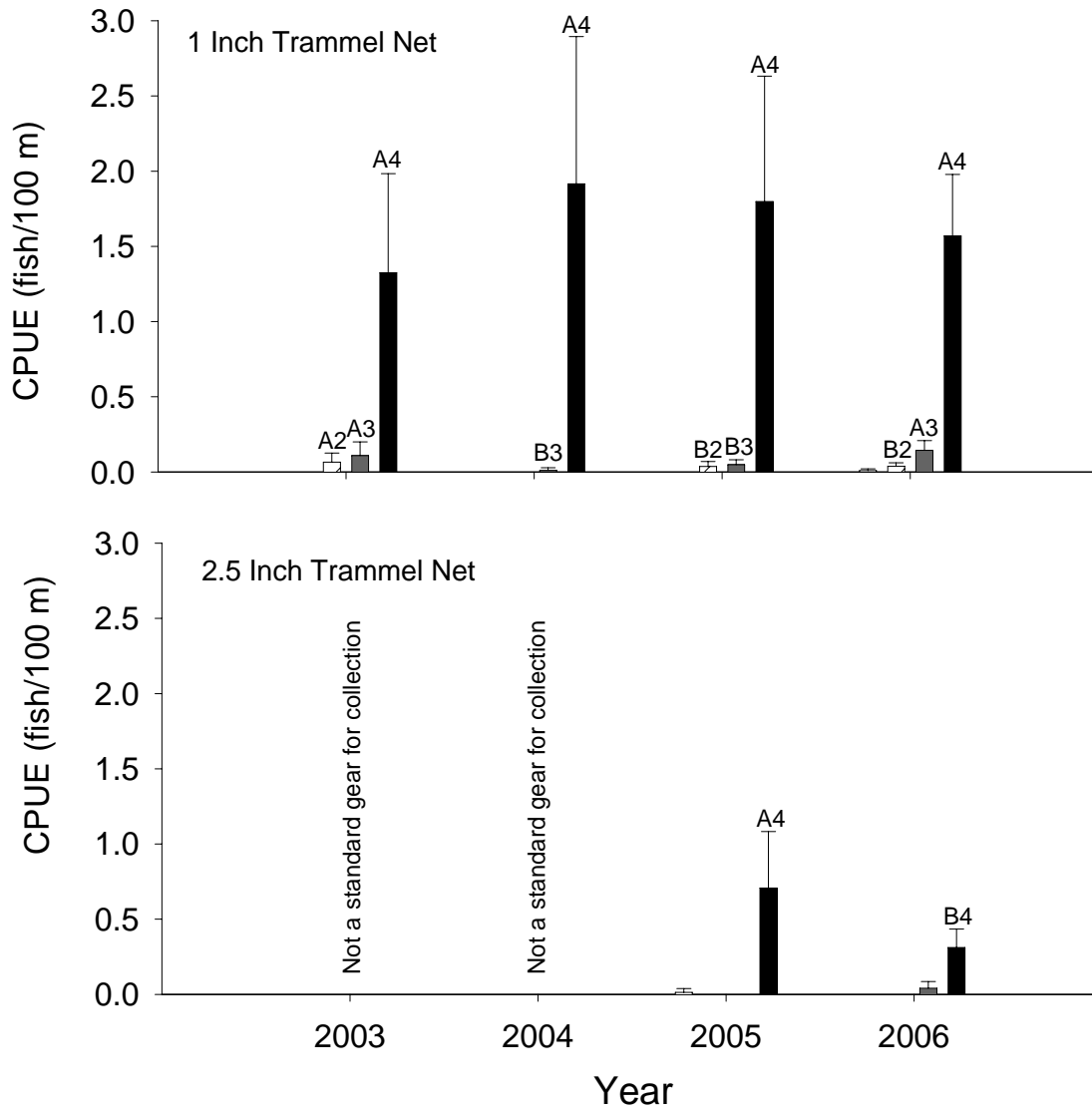


Figure 12. Mean annual catch-per-unit-effort (\pm 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249 mm; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon using 1 and 2.5 inch trammel nets in segment 9 of the Missouri River during sturgeon season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Shovelnose Sturgeon / Fish Community Season

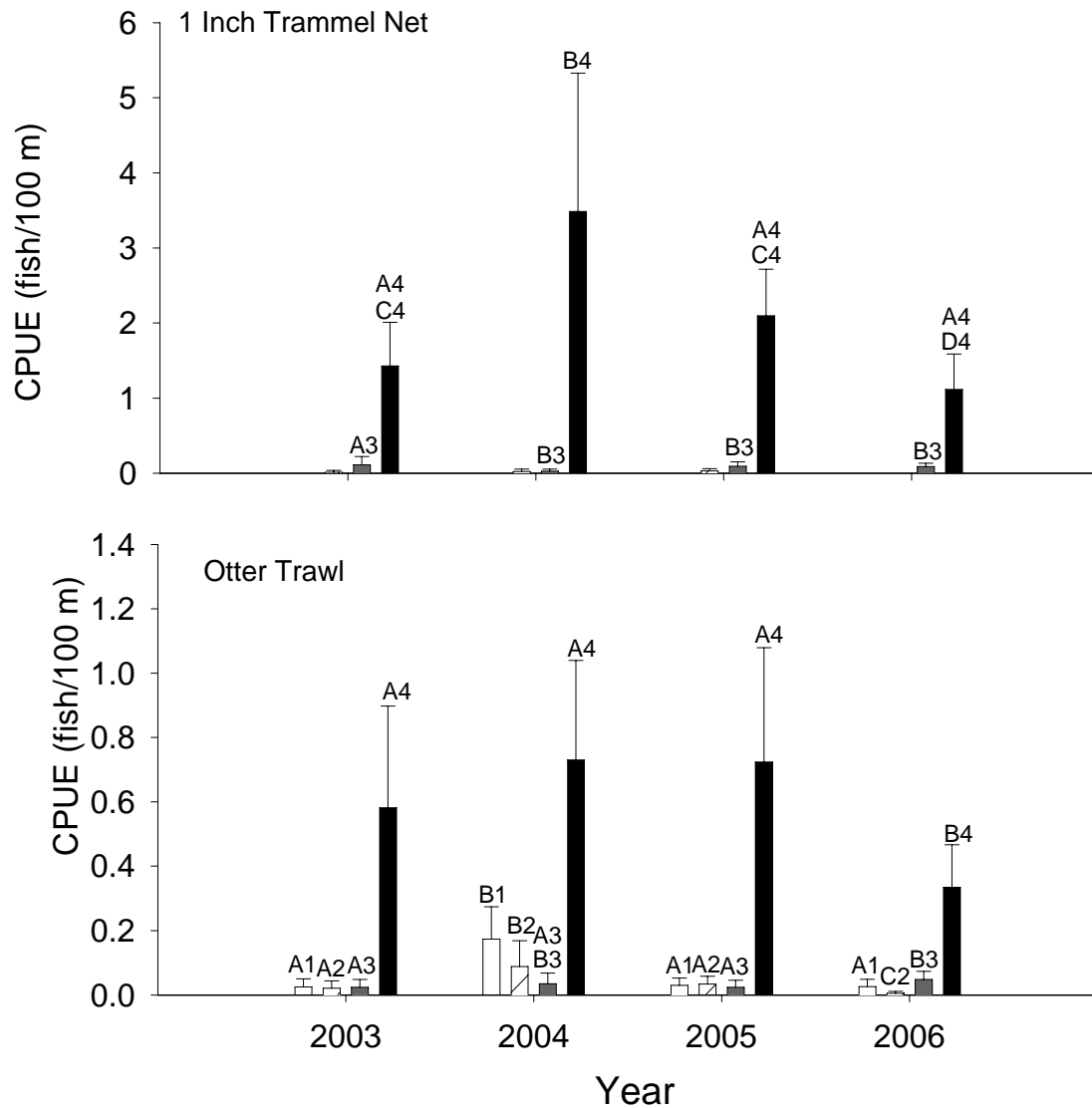


Figure 14. Mean annual catch-per-unit-effort (\pm 2SE) of sub-stock size (0-149 mm; white bars), sub-stock size (150-249; cross-hatched), stock size (250-379 mm; gray bars), and quality and above size (> 380 mm; black bars) shovelnose sturgeon using 1 inch trammel nets and otter trawls in segment 9 of the Missouri River during fish community season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Habitat Use

Twenty sub-stock (0 – 149 mm) shovelnose sturgeon were collected during the 2006 sampling season (Table 17). All sub-stock (0 – 149 mm) shovelnose sturgeon were collected using the otter trawl, seven during the sturgeon season and thirteen during the fish community season. Eighty-six percent of the sub-stock (0 – 149 mm) shovelnose sturgeon sampled during the sturgeon season were collected on the inside bend macrohabitats compared to 62% during the fish community season. Channel borders were the only mesohabitat where sub-stock (0 - 149 mm) sized shovelnose sturgeon were collected (Table 18).

Fifty-seven sub-stock (150 – 249 mm) shovelnose sturgeon were collected during the 2006 sampling season, with otter trawling (N = 40) being the most effective sampling method (Table 19). Otter trawling during the sturgeon season captured 37 sub-stock (150 – 249 mm) shovelnose sturgeon compared to 3 sampled during the fish community season. Sub-stock (150 – 249) shovelnose sturgeon were not collected in proportion to sampling efforts within the macrohabitats ($\chi^2 = 14.64$, $df = 5$, $P = 0.012$) (Table 20). The percent of sub-stock (150 – 249) shovelnose sturgeon captured within inside bend macrohabitats was much greater than the proportion of sampling effort.

One hundred forty-two stock size (250 – 379 mm) shovelnose sturgeon were sampled during 2006, 102 during the sturgeon season and 40 during the fish community season (Tables 21 and 22). Although the majority of stock size (250 – 379 mm) shovelnose sturgeon were collected from secondary connected channel large while trammel netting during the sturgeon season very little effort was expended in this macrohabitat. The majority of stock size shovelnose sturgeon were collected on channel border mesohabitats.

Over 3,000 quality and above size (> 380 mm) shovelnose sturgeon were sampled during 2006 (Tables 23 and 24). Inside bend macrohabitats was the primary habitat sampled during both seasons. Comparison between proportion caught and effort shows significant difference between all gear and seasons (sturgeon season 1.0" trammel nets; $\chi^2 = 37.05$, $df = 3$, $P = 0.001$, sturgeon season 2.5" trammel nets; $\chi^2 = 12.12$, $df = 3$, $P = 0.007$, sturgeon season otter trawl; $\chi^2 = 11.93$, $df = 5$, $P = 0.03$, fish community season 1.0" trammel nets; $\chi^2 = 50.28$, $df = 4$, $P = 0.001$ and fish community season 2.5" trammel nets; $\chi^2 = 30.25$, $df = 5$, $P = 0.001$), except for gill nets during the sturgeon season ($\chi^2 = 2.04$, $df = 4$, $P = 0.72$). Overall, more quality and above size shovelnose sturgeon were collected in the confluence and secondary connected channel large

macrohabitats than proportion of effort expended. Channel border mesohabitat was the principle habitat sampled for all gears during both seasons.

A total of 3,489 shovelnose sturgeon were measured during 2006 (Figure 17). The average fork length was 535 mm during the sturgeon season compared to 489 mm for the fish community season. The distribution between the two seasons were significantly different ($D = 0.38$, $P = 0.0003$). The length range for shovelnose sturgeon sampled during the sturgeon season was 56 to 851 mm compared to 56 to 668 mm for the fish community season.

PSD's for shovelnose sturgeon were 96 during the sturgeon season and 89 during the fish community season (Table 25). RSD preferred was 75 during the sturgeon season, but declined to 62 for the fish community season. RSD memorable was similar for the sturgeon and fish community seasons (4 and 2, respectively).

Table 17. Total number of sub-stock size (0-149 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net		N-E	17	4	N-E	N-E	60		19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net			23	1			71	3	2						
Otter Trawl	7		19	1			86 65	1	14 11				3		
Fish Community Season (Summer)															
1 Inch Trammel Net		N-E	23	2	N-E	N-E	70		5		N-E				
Mini-Fyke Net			27				55	12	2				1	3	
Otter Trawl	13		19	2			62 66		38 10				2		

Table 18. Total number of sub-stock size (0-149 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net			100	N-E		
2.5 Inch Trammel Net			100			
Gill Net			58		42	
Otter Trawl	7		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net			100	N-E		
Mini-Fyke Net		100				
Otter Trawl	13		100 100			

Table 19. Total number of sub-stock size (150-249 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	12	N-E	17	4	N-E	N-E	75 60		25 19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net	5		40 23	1			60 71	3	2						
Otter Trawl	37		8 19	1			86 65	1	5 11				3		
Fish Community Season (Summer)															
1 Inch Trammel Net		N-E	23	2	N-E	N-E	70		5		N-E				
Mini-Fyke Net			27				55	12	2				1	3	
Otter Trawl	3		19	2			100 66		10				2		

Table 20. Total number of sub-stock size (150-249 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	12		100 100	N-E		
2.5 Inch Trammel Net			100			
Gill Net	5		100 58		42	
Otter Trawl	37		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net			100	N-E		
Mini-Fyke Net		100				
Otter Trawl	3		100 100			

Table 21. Total number of stock size (250-379 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	60	N-E	17	3 4	N-E	N-E	28 60		68 19		N-E				
2.5 Inch Trammel Net	4		25 24	1			75 72		3						
Gill Net	17		18 23	6 1			76 71	3	2						
Otter Trawl	21		19 19	1			67 65	5 1	10 11				3		
Fish Community Season (Summer)															
1 Inch Trammel Net	23	N-E	4 23	2	N-E	N-E	57 70		39 5		N-E				
Mini-Fyke Net			27				55	12	2				1	3	
Otter Trawl	17		6 19	2			88 66		6 10				2		

Table 22. Total number of stock size (250-379 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	60		100 100	N-E		
2.5 Inch Trammel Net	4		100 100			
Gill Net	17		35 58		65 42	
Otter Trawl	21		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net	23		100 100	N-E		
Mini-Fyke Net		100				
Otter Trawl	17		100 100			

Table 23. Total number of quality size and greater (≥ 380 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	538	N-E	2 17	10 4	N-E	N-E	35 60		53 19		N-E				
2.5 Inch Trammel Net	60		20 24	5 1			60 72		15 3						
Gill Net	1912		24 23	2 1			65 71	4 3	5 2						
Otter Trawl	195		31 19	5 1			43 65	1 1	16 11				6 3		
Fish Community Season (Summer)															
1 Inch Trammel Net	257	N-E	15 23	4 2	N-E	N-E	44 70		37 5		N-E				
Mini-Fyke Net			27				55	12	2				1	3	
Otter Trawl	110		10 19	3 2			72 66		15 10				2		

Table 24. Total number of quality size and greater (≥ 380 mm) shovelnose sturgeon captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. Size categories described in Table 25. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	538		100 100	N-E		
2.5 Inch Trammel Net	60		100 100			
Gill Net	1912		38 58		62 42	
Otter Trawl	195		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net	257		100 100	N-E		
Mini-Fyke Net		100				
Otter Trawl	110		100 100			

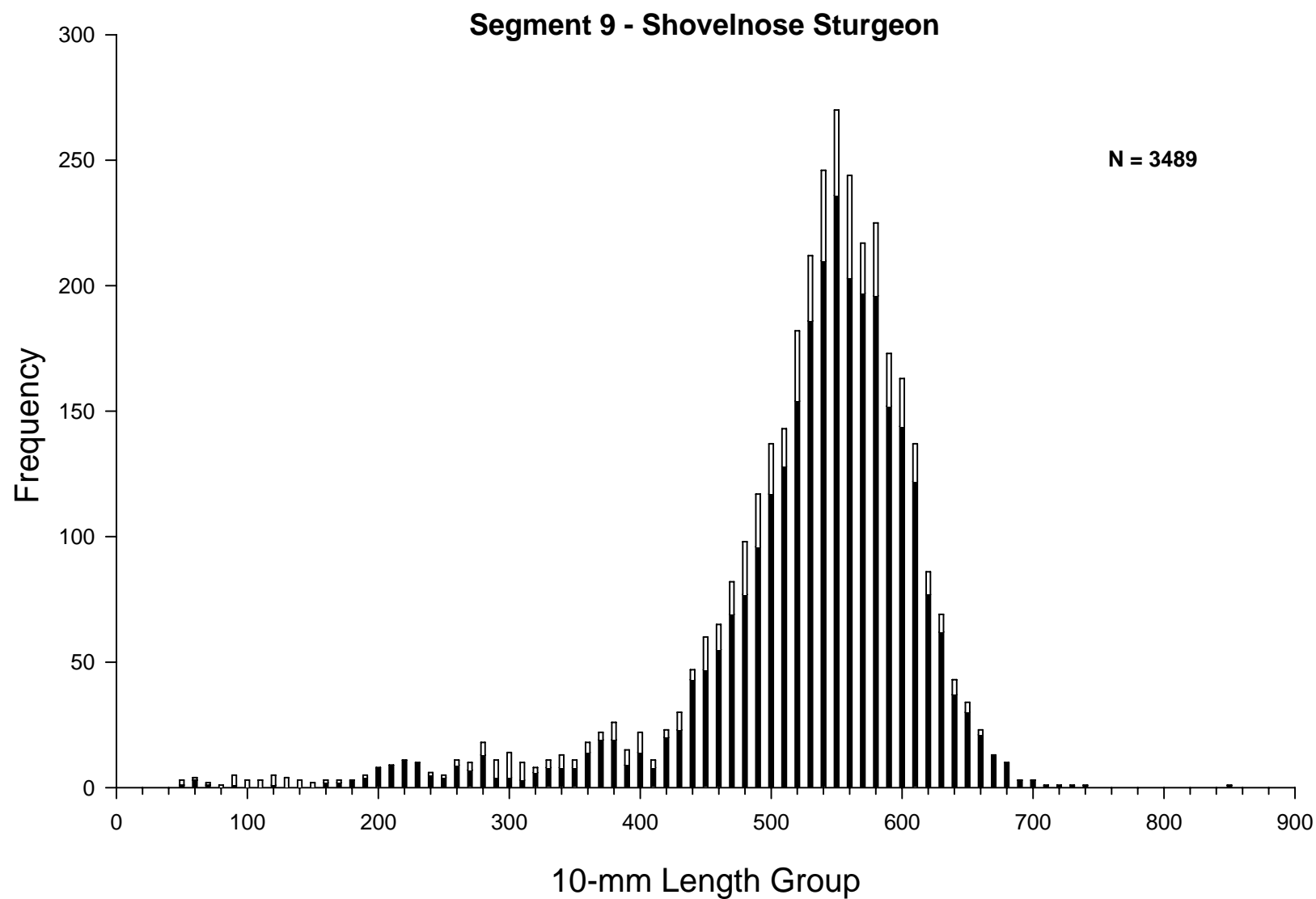


Figure 17. Length frequency of shovelnose sturgeon from fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 9 of the Missouri River during 2006.

Table 25. Incremental relative stock density (RSD)^a and mean relative weight (Wr) by a length category for shovelnose sturgeon in segment 9 of the Missouri River captured during 2006. Length categories^b determined using methods proposed by Quist (1998).

Length category	N	RSD	Wr (+/- 2SE)
Sturgeon Season			
Sub-stock (0-149 mm)	7		
Sub-stock (150-249 mm)	54		
Stock (250-379 mm)	2,893		95 (7)
Quality (380-509 mm)	2,786	96	88 (1)
Preferred (510-639 mm)	2,189	75	86 (< 1)
Memorable (640-809 mm)	122	4	81 (2)
Trophy (> 810 mm)	1	< 1	
Overall Wr			88 (1)
Fish Community Season			
Sub-stock (0-149 mm)	26		
Sub-stock (150-249 mm)	6		
Stock (250-379 mm)	503		90 (4)
Quality (380-509 mm)	448	89	90 (3)
Preferred (510-639 mm)	312	62	82 (1)
Memorable (640-809 mm)	12	2	76 (6)
Trophy (> 810 mm)			
Overall Wr			81 (3)

^a RSD = (# of fish of a specified length class / # of fish \geq minimum stock length fish) * 100.

^b Length categories based on the percentage of the largest known shovelnose sturgeon: Sub-stock (20 %), Stock (20 – 36 %), Quality (36 – 45 %), Preferred (45 – 59 %), Memorable (59 – 74 %), Trophy (>74 %).

Sturgeon Chub

A total of 301 sturgeon chubs were captured during 2006 with 115 captured in standard gears and 186 in wild gears. Standard gears during 2006 included: otter trawls (N = 113) and mini-fyke nets (N = 2). Wild gears during 2006 included: 4-mm otter trawl (N = 186). Catch per unit effort for otter trawling during the 2005 sturgeon season was significantly different compared to 2003 ($\chi^2 = 22.95$, $P = < 0.0001$), 2004 ($\chi^2 = 19.56$, $P = < 0.0001$) and 2006 ($\chi^2 = 43.42$, $P = < 0.0001$) (Figure 18). Sturgeon chubs trends continue to increase significantly for otter trawls during the fish community season ($\chi^2 = 29.96$, $P = < 0.0001$) (Figure 19). Only two sturgeon chubs were collected with mini-fyke nets in 2006 (Figure 20). This resulted in a catch per unit effort of 0.01 fish per net night.

The majority of sturgeon chubs collected with otter trawls during the sturgeon season were sampled on the inside bends (45%) and channel cross-overs (36%) (Table 26) and all were collected within the channel border mesohabitat (Table 27). Otter trawling during the fish community season showed no significant difference between percent caught and percent effort within macrohabitats ($\chi^2 = 4.66$, $df = 4$, $P = 0.324$).

Eleven sturgeon chubs were sampled during the sturgeon season and 290 were sampled during the fish community season with all gears (Figure 21). The average fork length was 60.1 mm during the sturgeon season and 42.3 during the fish community season. The distribution between the two season were significantly different ($D = 0.71$, $P = 0.0275$) with the fish community season collecting a larger ranging length distribution. The length range for sturgeon chubs sampled during the sturgeon season was 39 to 92 mm compared to 22 to 93 mm during the fish community season.

Segment 9 - Sturgeon Chub / Sturgeon Season

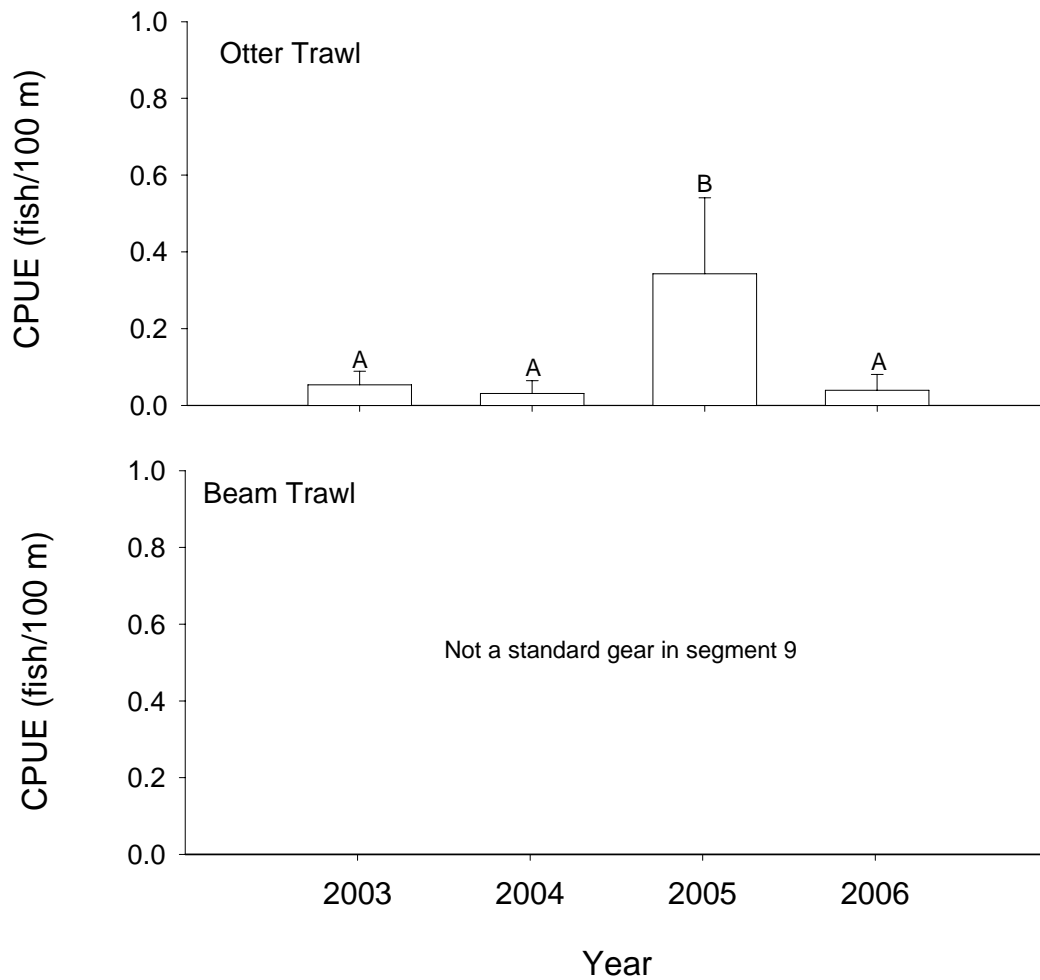


Figure 18. Mean annual catch-per-unit-effort ($\pm 2SE$) of sturgeon chub using otter trawls and beam trawls in segment 9 of the Missouri River during sturgeon season 2003-2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Sturgeon Chub / Fish Community Season

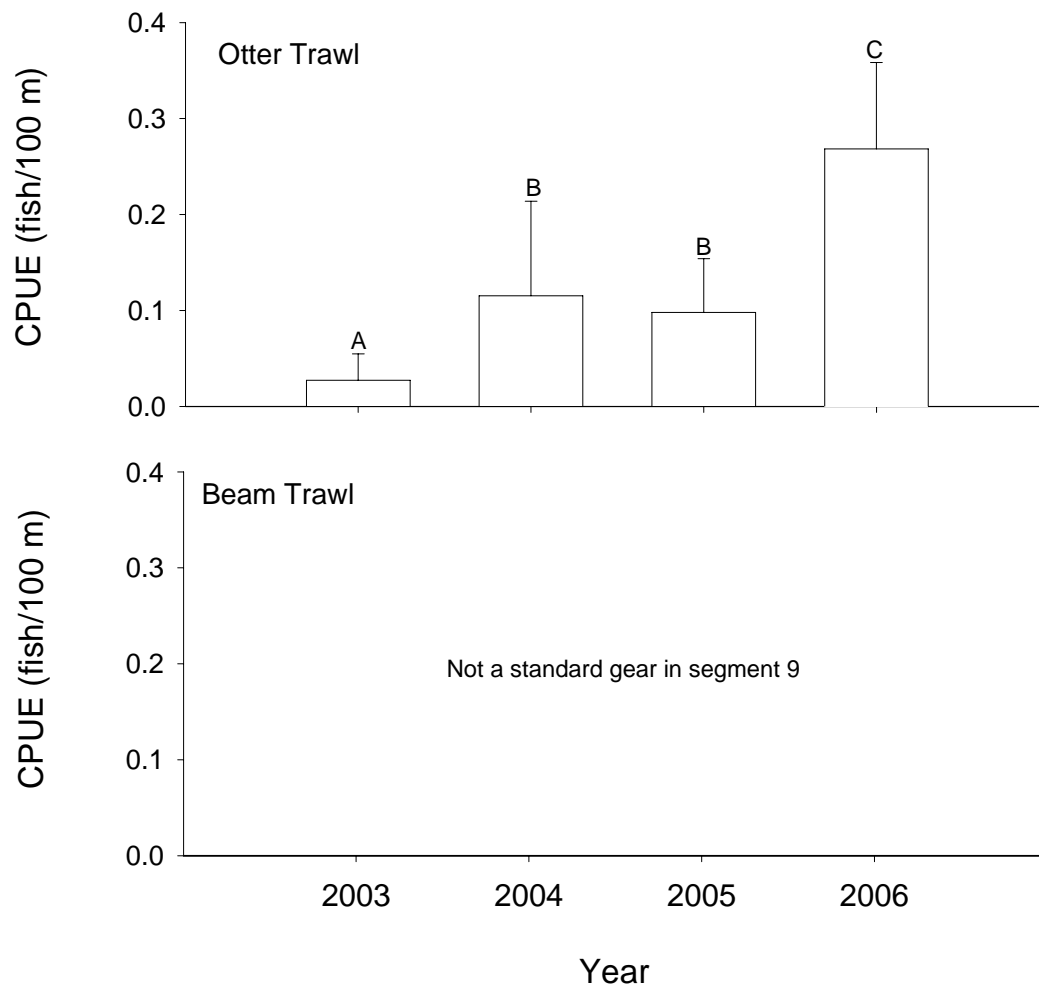


Figure 19. Mean annual catch-per-unit-effort ($\pm 2SE$) of sturgeon chub using otter trawls and beam trawls in segment 9 of the Missouri River during fish community season 2003-2006. Letter denote a significant difference in yearly comparisons.

Segment 9 - Sturgeon Chub / Fish Community Season

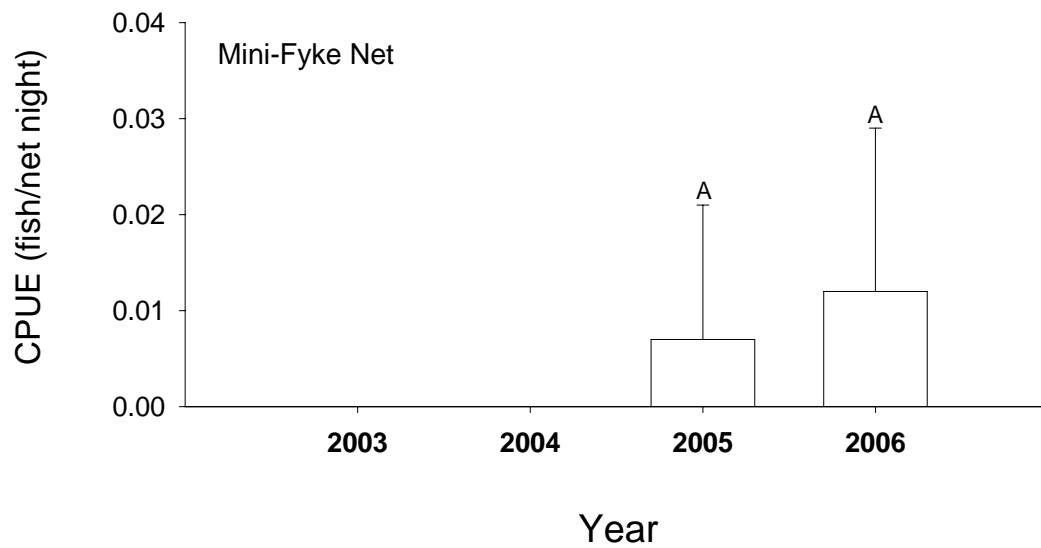


Figure 20. Mean annual catch-per-unit-effort (\pm 2SE) of sturgeon chub using mini-fyke nets and bag seines in segment 9 of the Missouri River during fish community season 2003-2006. Letter denote a significant difference in yearly comparisons.

Table 26. Total number of sturgeon chubs captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net		N-E	17	4	N-E	N-E	60		19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net			23	1			71	3	2						
Otter Trawl	11		19 19	1			45 65	1	36 11				3		
Fish Community Season (Summer)															
1 Inch Trammel Net		N-E	23	2	N-E	N-E	70		5		N-E				
Mini-Fyke Net	2		50 27				50 55	12	2				1	3	
Otter Trawl	102		12 19	1 2			76 66		11 10				2		

Table 27. Total number of sturgeon chubs captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net			100	N-E		
2.5 Inch Trammel Net			100			
Gill Net			58		42	
Otter Trawl	11		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net			100	N-E		
Mini-Fyke Net	2	100 100				
Otter Trawl	102		100 100			

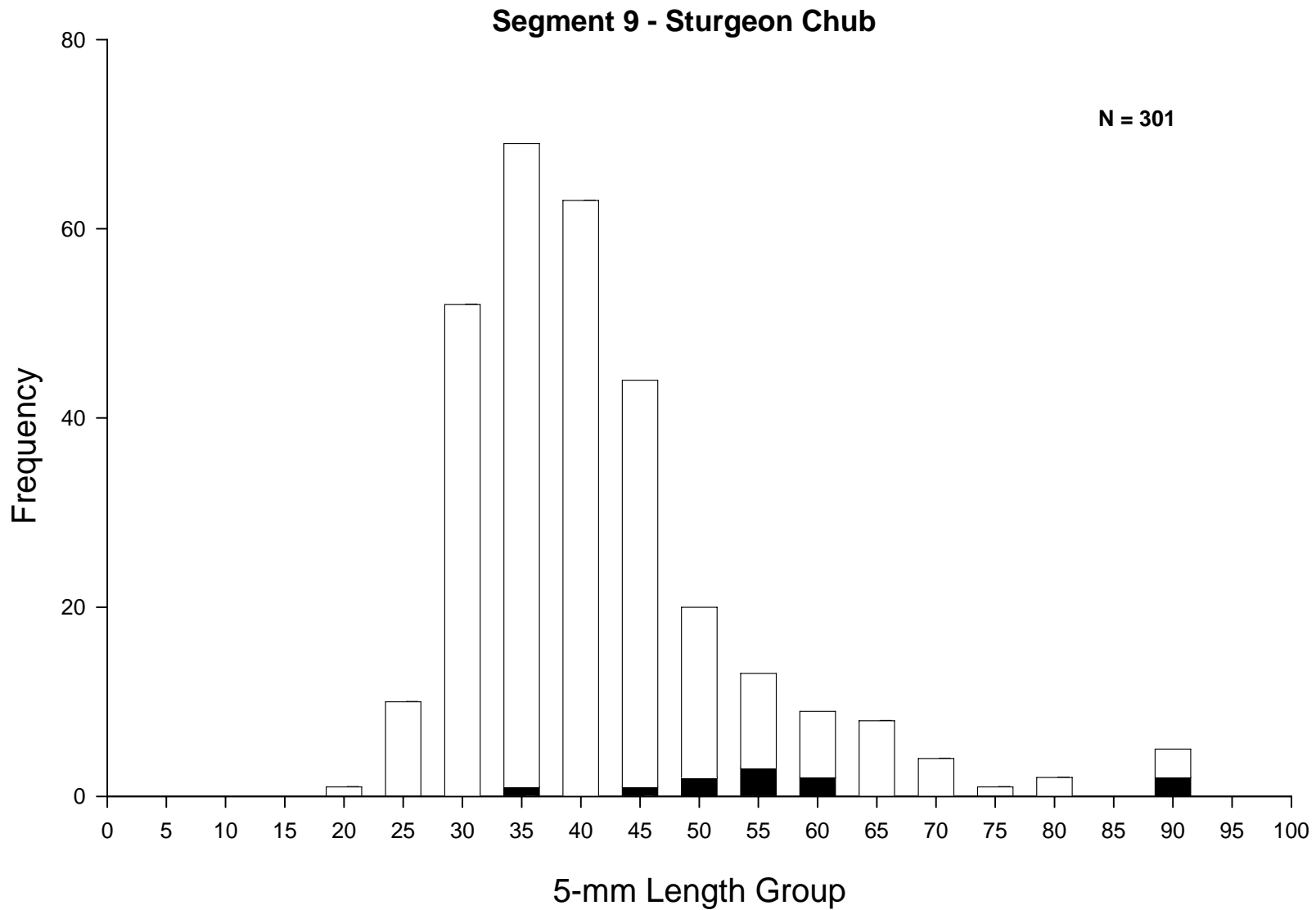


Figure 21. Length frequency of sturgeon chubs during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 9 of the Missouri River during 2006.

Sicklefin Chub

A total of 261 sicklefin chubs were sampled during 2006 with 166 captured in standard gears and 95 in wild gears. Standard gears during 2006 included: otter trawls (N = 166). Wild gears during 2006 included: 4-mm otter trawls (N = 95). Catch per unit effort trends for otter trawling during the sturgeon season has significantly increased since 2003 ($\chi^2 = 40.73$, $P = < 0.0001$) (Figure 22). Otter trawling CPUE's during the 2005 fish community season was significantly different compared to 2003 ($\chi^2 = 15.16$, $P = < 0.0001$), 2004 ($\chi^2 = 16.82$, $P = < 0.0001$) and 2006 ($\chi^2 = 20.41$, $P = < 0.0001$) (Figure 23). No sicklefin chubs were collected with mini-fyke nets in 2006 compared to 4 during 2005 (Figure 24).

All sicklefin chubs collected with standard gears were collected with otter trawls. Ninety-one fish were collected during the sturgeon season and 75 fish were collected during the fish community season. Otter trawling during both seasons showed a significant difference between percent caught and percent effort within macrohabitats (sturgeon season: $\chi^2 = 13.682$, $df = 5$, $P = 0.018$, fish community season: $\chi^2 = 15.52$, $df = 4$, $P = 0.004$) (Table 28). All sicklefin chubs were collected in channel border mesohabitats (Table 29).

A total of 261 sicklefin chubs were measured during 2006, with 107 being sampled in the fish community season (Figure 25). The average fork length was 58.8 mm during the sturgeon season and 53.7 mm during the fish community season. The length distribution between the two seasons were not significantly different ($D = 0.26$, $P = 0.540$). The length range for sturgeon chubs sampled during the sturgeon season was 29 to 112 mm compared to 21 to 114 mm during the fish community season.

Segment 9 - Sicklefin Chub / Sturgeon Season

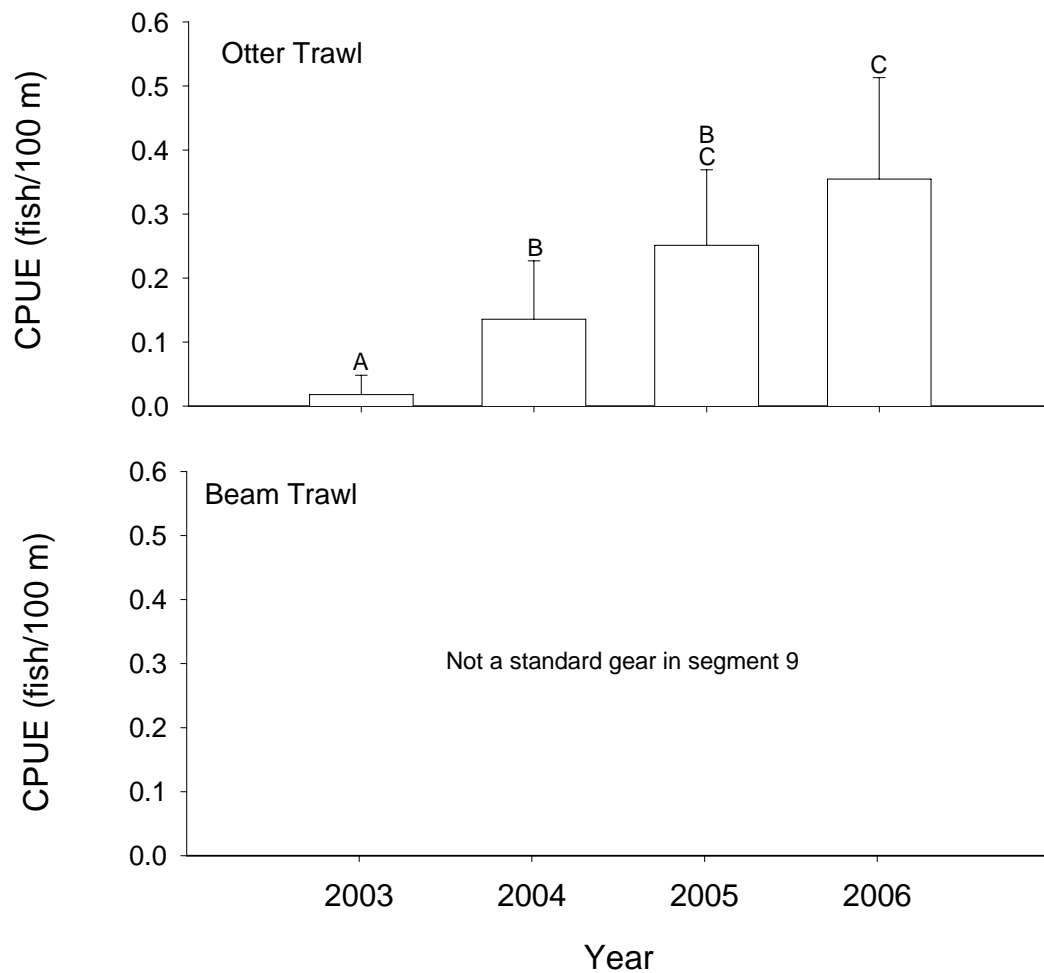


Figure 22. Mean annual catch-per-unit-effort (\pm 2SE) of sicklefin chub using otter trawls and beam trawls in segment 9 of the Missouri River during sturgeon season 2003-2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Sicklefin Chub / Fish Community Season

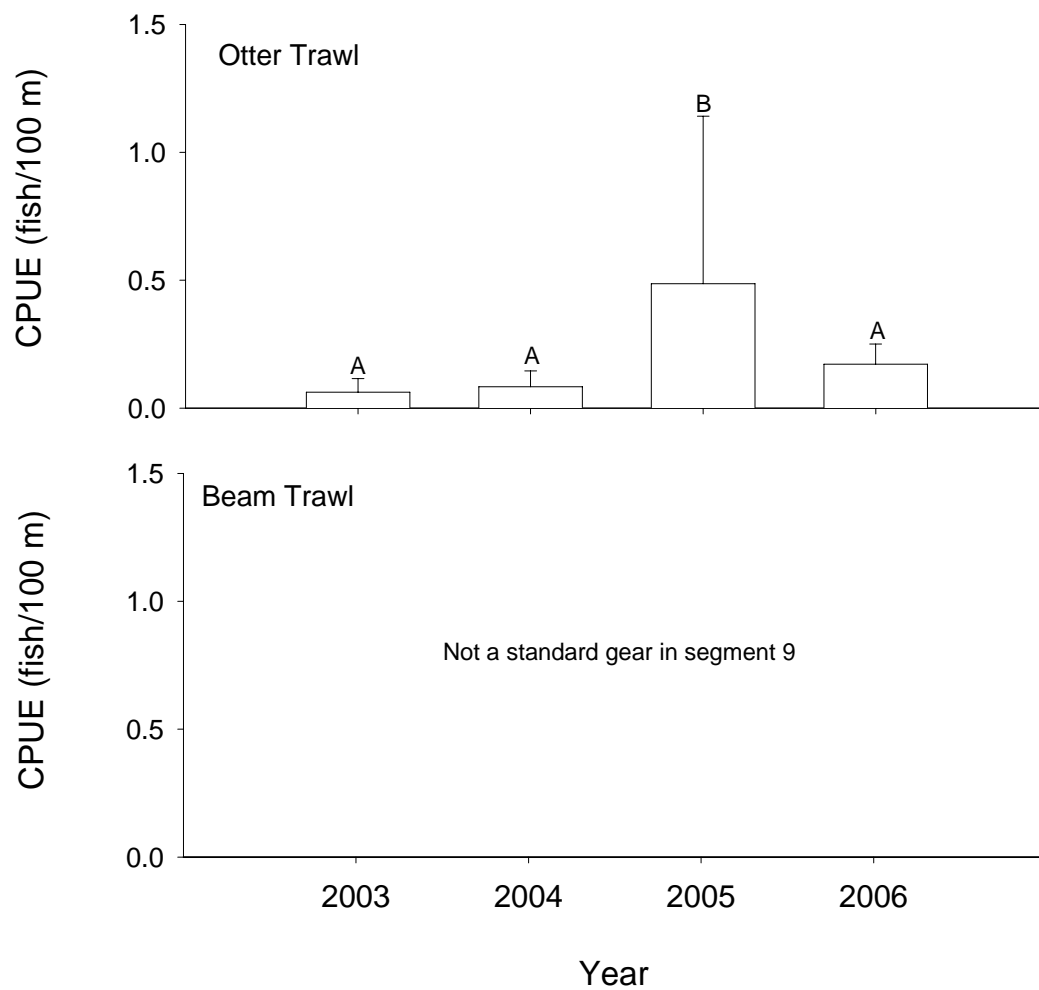


Figure 23. Mean annual catch-per-unit-effort ($\pm 2SE$) of sicklefin chub using otter trawls and beam trawls in segment 9 of the Missouri River during fish community season 2003-2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Sicklefin Chub / Fish Community Season

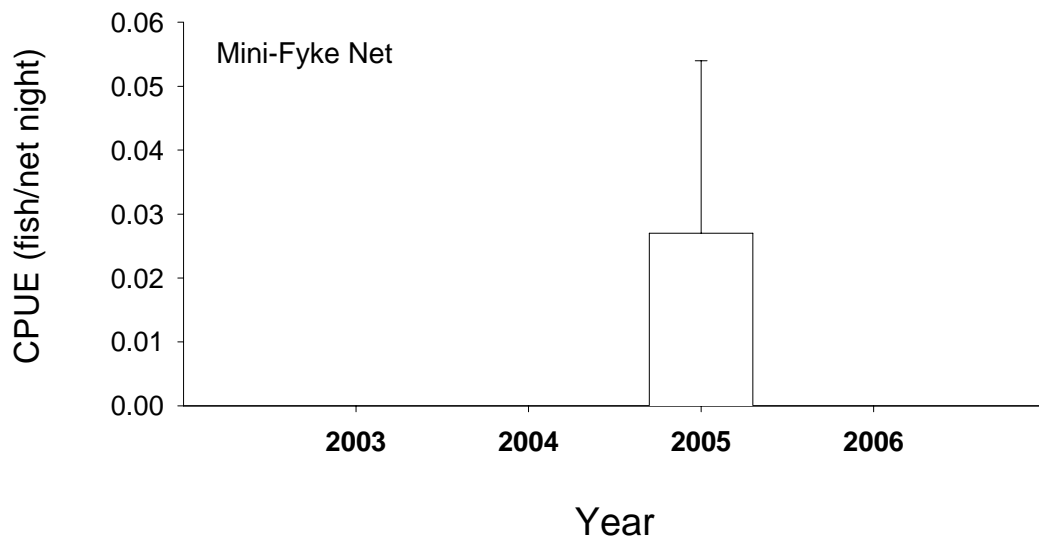


Figure 24. Mean annual catch-per-unit-effort ($\pm 2SE$) of sicklefin chub using mini-fyke nets in segment 9 of the Missouri River during fish community season 2003-2006.

Table 28. Total number of sicklefin chubs captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net		N-E	17	4	N-E	N-E	60		19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net			23	1			71	3	2						
Otter Trawl	91		26 19	1			71 65	1 1	1 11				3		
Fish Community Season (Summer)															
1 Inch Trammel Net		N-E	23	2	N-E	N-E	70		5		N-E				
Mini-Fyke Net			27				55	12	2				1	3	
Otter Trawl	75		19 19	2			81 66		10				2		

Table 29. Total number of sicklefin chubs captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net			100	N-E		
2.5 Inch Trammel Net			100			
Gill Net			58		42	
Otter Trawl	91		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net			100	N-E		
Mini-Fyke Net		100				
Otter Trawl	75		100 100			

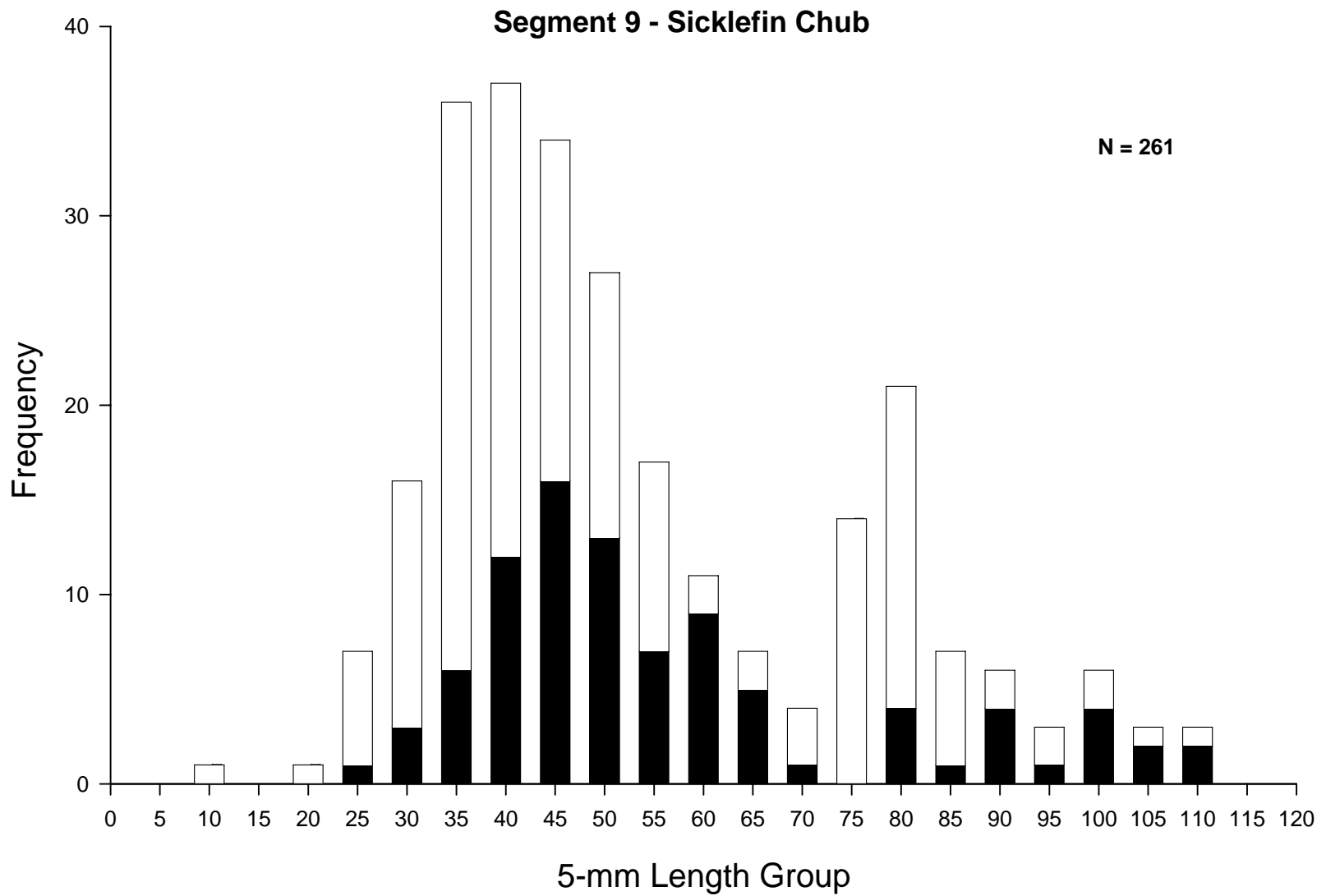


Figure 25. Length frequency of sicklefin chubs during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 9 of the Missouri River during 2006.

Speckled Chub

A total of 879 speckled chubs were sampled during 2006 with 348 captured in standard gears and 531 in wild gears. Standard gears during 2006 included: otter trawls (N = 346) and mini-fyke nets (N = 2). Wild gears during 2006 included: 4-mm otter trawls (N = 531). Catch per unit effort trends for otter trawling during the sturgeon season has been on a significant increase from 2003 ($\chi^2 = 9.49$, $P = 0.002$) (Figure 26). Otter trawling CPUE's during the 2004 fish community season was significantly different compared 2003 ($\chi^2 = 10.07$, $P = 0.0015$), 2005 ($\chi^2 = 24.62$, $P = < 0.0001$) and 2006 ($\chi^2 = 15.53$, $P = < 0.0001$) (Figure 27). Catch per unit effort has ranged from 0.35 fish per 100m trawled in 2005 to 1.08 fish per 100 m trawled in 2004. Two speckled chubs were collected while mini-fyke netting, resulting in a CPUE of 0.01 fish per net night (Figure 28). Mini-fyke net catch rates have decreased significantly every year since 2004 ($\chi^2 = 3.96$, $P = < 0.0465$).

The majority of speckled chubs (346 of 348) sampled with standard gears were collected while otter trawling with 170 captured during the sturgeon season and 176 captured during the fish community season (Table 30). Otter trawling during both seasons showed a significant difference between percent caught and percent effort within macrohabitats (sturgeon season: $\chi^2 = 13.68$, $df = 5$, $P = 0.018$, fish community season: $\chi^2 = 12.51$, $df = 4$, $P = 0.014$). Channel border mesohabitats are the only habitat where otter trawls are deployed and therefore the only location where speckled chubs were collected (Table 31).

A total of 879 speckled chubs were measured during 2006, with 709 being sampled during the fish community season (Figure 29). The average fork length was 50.6 mm during the sturgeon season and 43.6 mm during the fish community season. The length distribution between the two season were not significantly different ($D = 0.31$, $P = 0.569$). The length range for speckled chubs sampled during the sturgeon season was 28 to 112 mm compared to 17 to 77 mm during the fish community season.

Segment 9 - Speckled Chub / Sturgeon Season

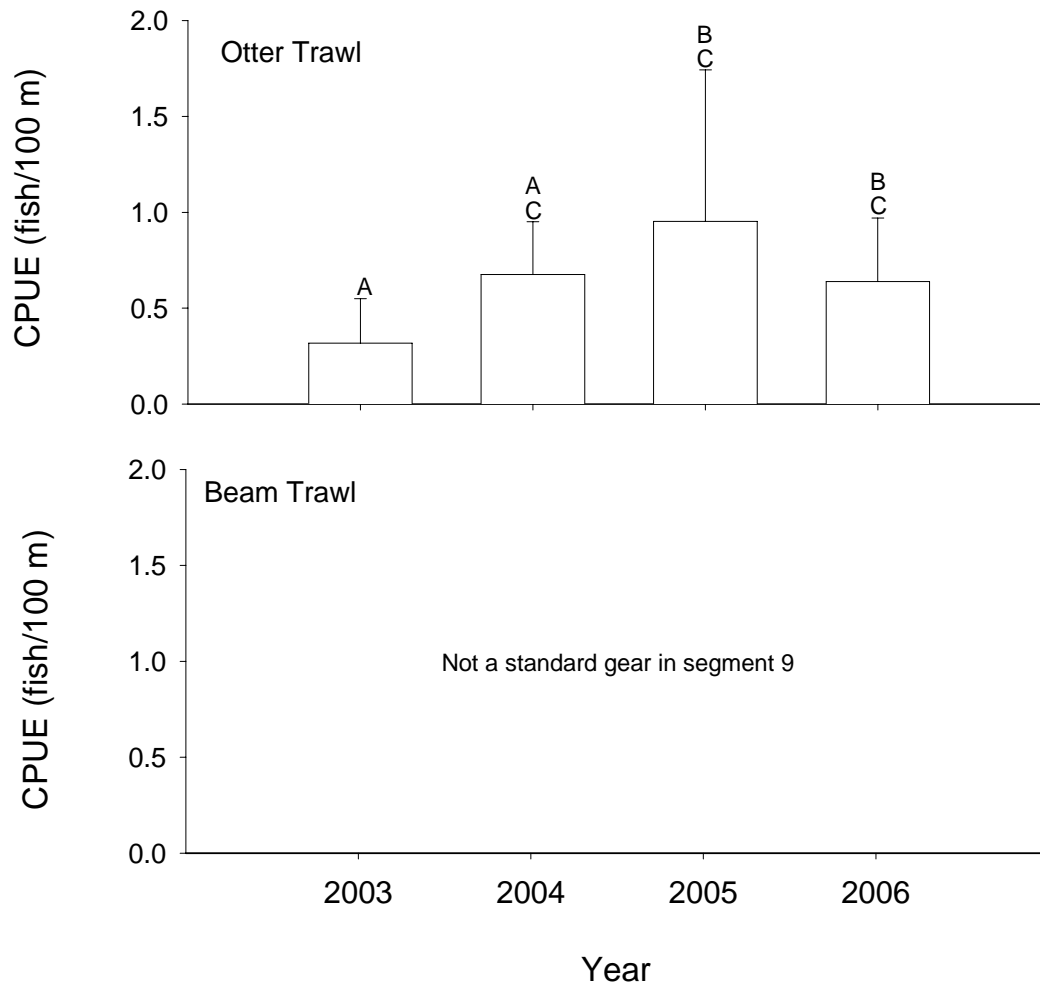


Figure 26. Mean annual catch-per-unit-effort (± 2 SE) of speckled chub using otter trawls and beam trawls in segment 9 of the Missouri River during sturgeon season 2003 -2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Speckled Chub / Fish Community Season

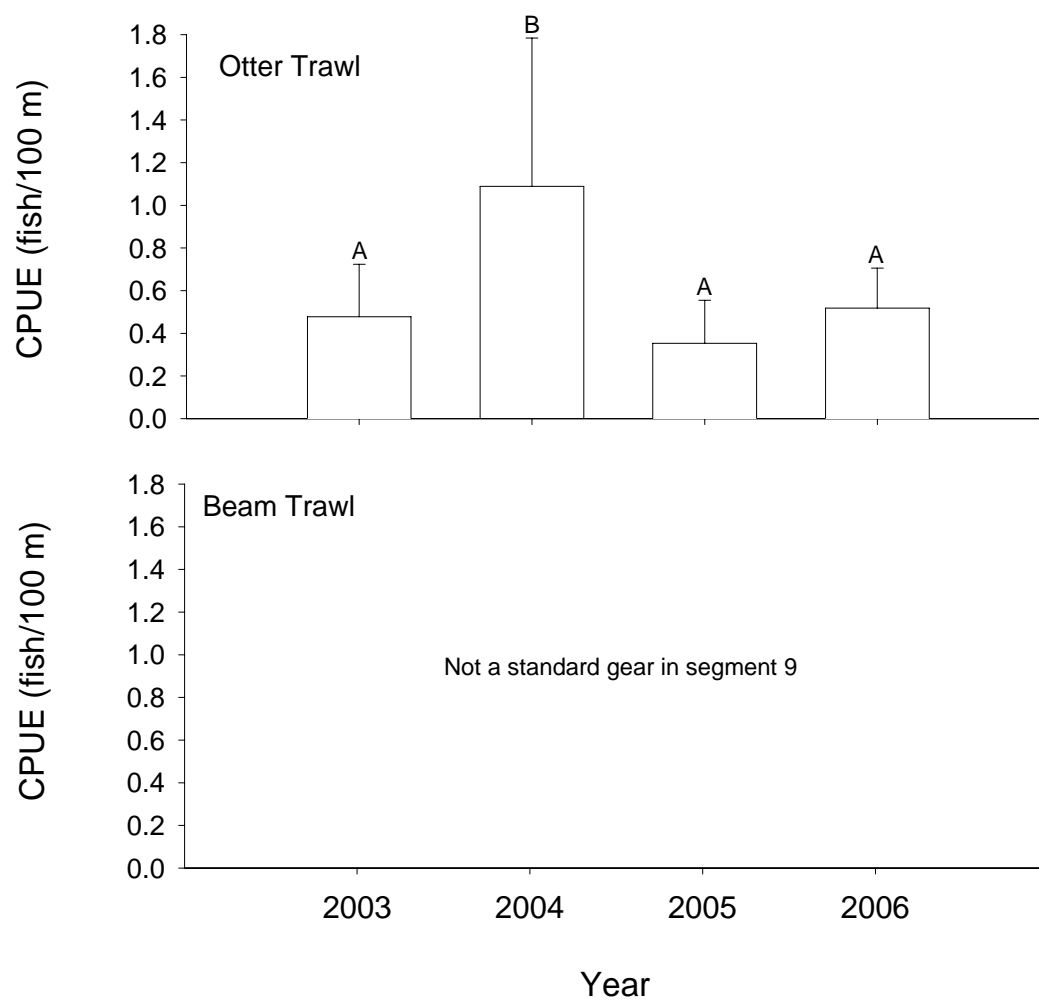


Figure 27. Mean annual catch-per-unit-effort (\pm 2SE) of speckled chub in segment 9 of the Missouri River during fish community season 2003 -2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Speckled Chub / Fish Community Season

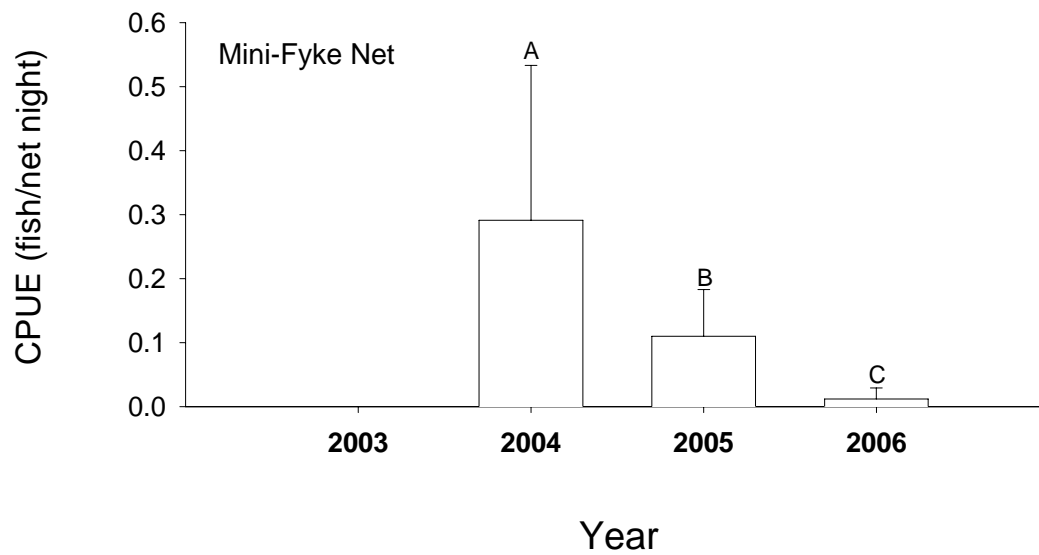


Figure 28. Mean annual catch-per-unit-effort ($\pm 2SE$) of speckled chub using mini-fyke nets in segment 9 of the Missouri River during fish community season 2003 -2006. Letters denote a significant difference in yearly comparisons.

Table 30. Total number of speckled chubs captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net		N-E	17	4	N-E	N-E	60		19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net			23	1			71	3	2						
Otter Trawl	170		12 19	1 1			53 65	1	33 11				1 3		
Fish Community Season (Summer)															
1 Inch Trammel Net		N-E	23	2	N-E	N-E	70		5		N-E				
Mini-Fyke Net	2		27				50 55	12	50 2				1	3	
Otter Trawl	176		7 19	1 2			87 66		3 10				2 2		

Table 31. Total number of speckled chubs captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net			100	N-E		
2.5 Inch Trammel Net			100			
Gill Net			58		42	
Otter Trawl	170		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net			100	N-E		
Mini-Fyke Net	2	100 100				
Otter Trawl	176		100 100			

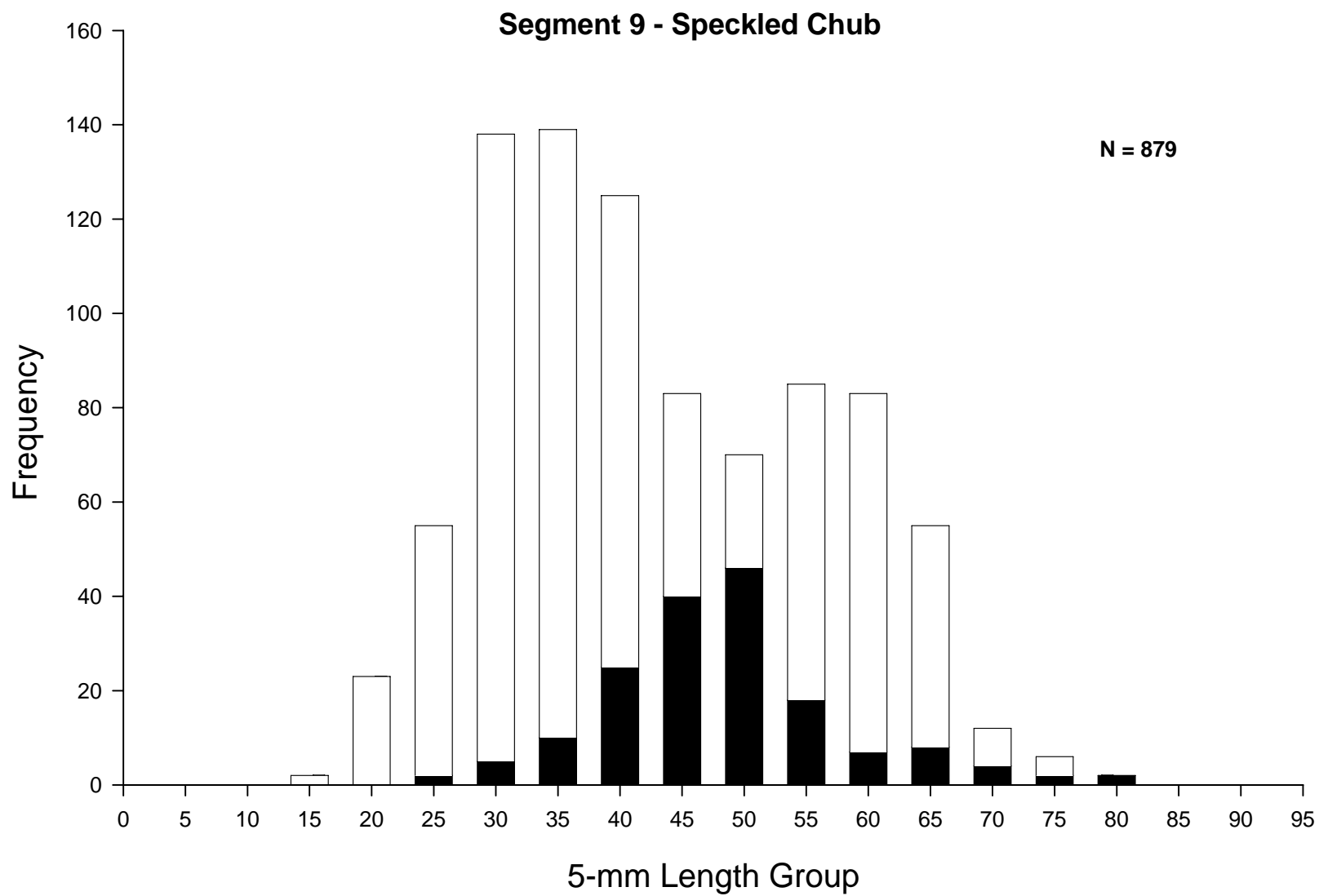


Figure 29. Length frequency of speckled chubs during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 9 of the Missouri River during 2006.

Sand Shiner

A total of 1,383 sand shiners were sampled during 2006 with 1,364 captured in standard gears. Standard gears during 2006 included: mini-fyke nets ($N = 1,336$) and otter trawls ($N = 25$). Otter trawls remain an ineffective gear for sampling sand shiners. Only one sand shiner was collected during the sturgeon season and twenty-four during the fish community season, resulting in a catch per unit effort of 0.003 and 0.07 fish per 100 m trawled, respectively (Figures 30 and 31). One thousand three hundred thirty-six sand shiners were collected while mini-fyke netting during the 2006 sampling season. This resulted in a CPUE of 8.04 fish per net night (Figure 32). Mini-fyke net catch per unit effort trends has increased significantly from 2003 ($\chi^2 = 1587.89$, $P = < 0.0001$).

The majority of sand shiners collected while mini-fyke netting during the fish community season were sampled on the inside bend macrohabitats (60%), followed by channel cross-overs macrohabitats (30%) (Table 32). The number of sand shiners caught versus effort expended did not significantly differ ($\chi^2 = 10.72$, $df = 5$, $P = 0.057$). All sand shiners collected while otter trawling during both seasons were collected on channel border mesohabitats and from bar mesohabitats for mini-fyke nets (Table 33).

A total of 747 sand shiners were measured during 2006, 746 during the fish community season (Figure 33). The average fork length was 37.3 mm during the fish community season. The length range for sand shiners sampled during the fish community season was 24 to 60 mm.

Segment 9 - Sand Shiner / Sturgeon Season

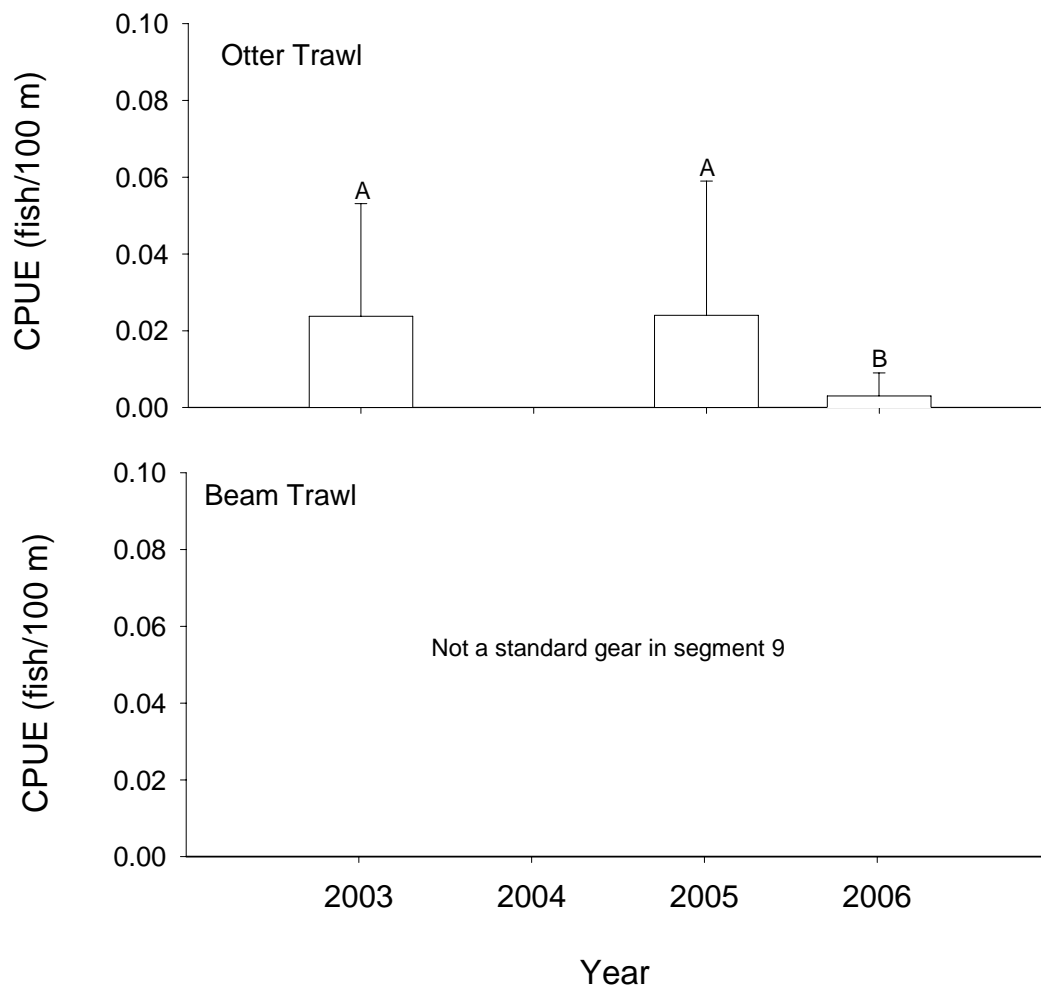


Figure 30. Mean annual catch-per-unit-effort ($\pm 2SE$) of sand shiner with otter trawls and beam trawls in segment 9 of the Missouri River during sturgeon season 2003 -2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Sand Shiner / Fish Community Season

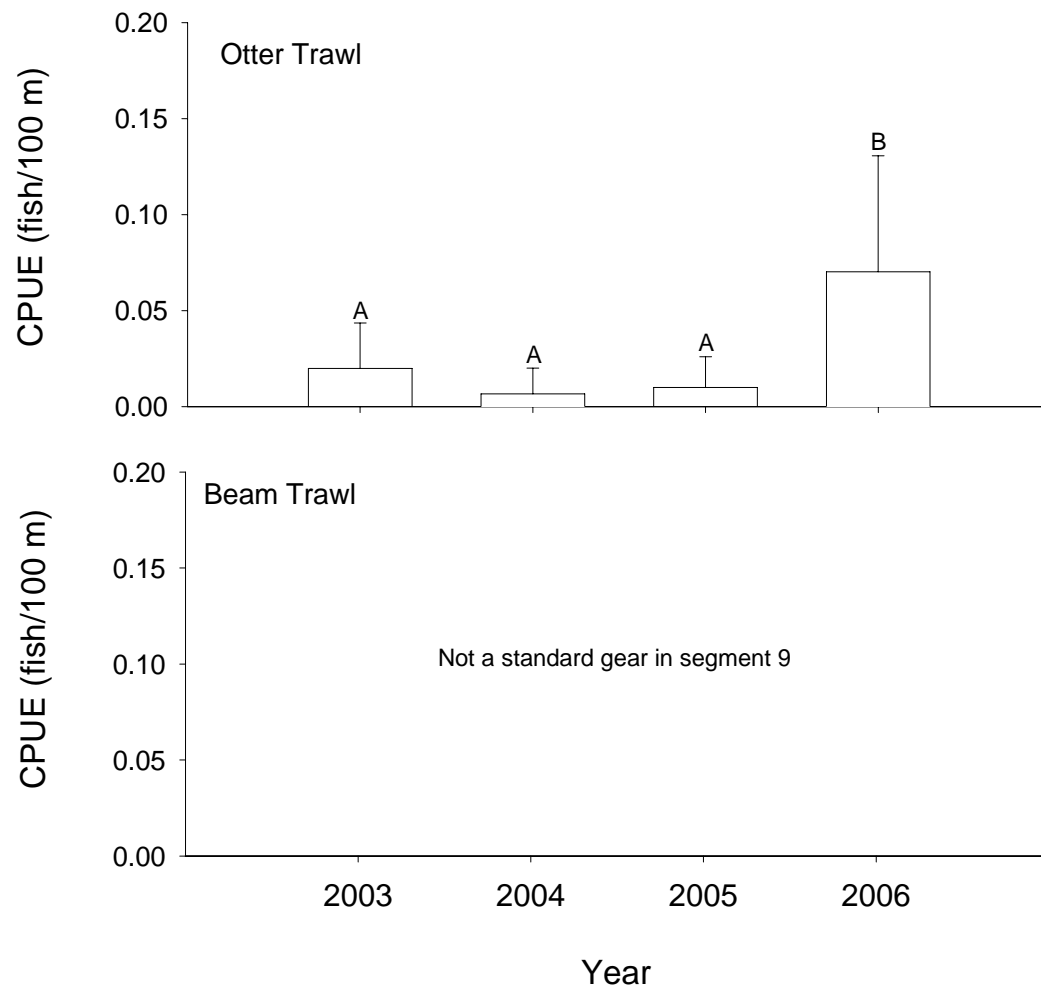


Figure 31. Mean annual catch-per-unit-effort ($\pm 2SE$) of sand shiner with otter trawls and beam trawls in segment 9 of the Missouri River during fish community season 2003 -2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Sand Shiner / Fish Community Season

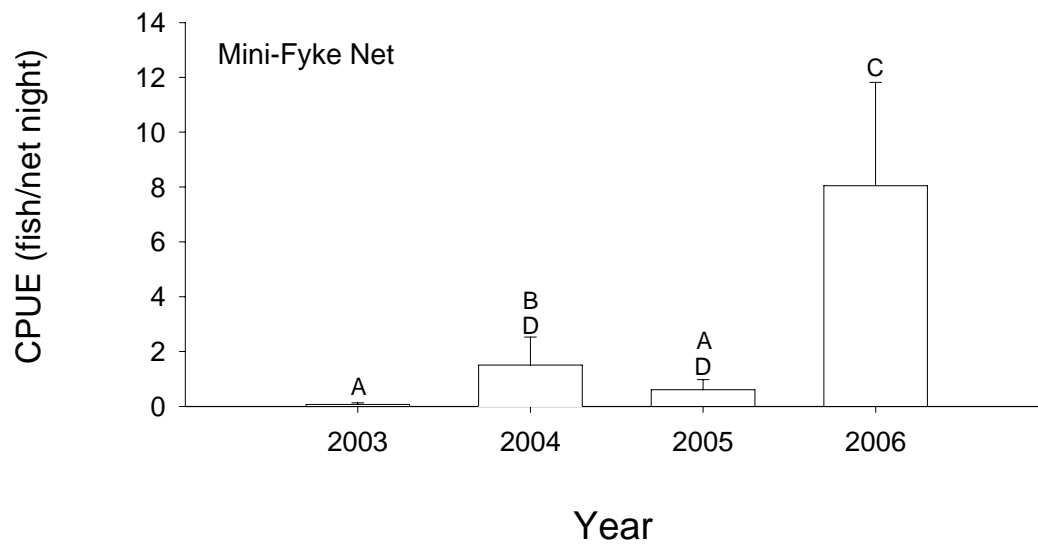


Figure 32. Mean annual catch-per-unit-effort (\pm 2SE) of sand shiner with mini-fyke nets in segment 9 of the Missouri River during fish community season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Table 32. Total number of sand shiners captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net		N-E	17	4	N-E	N-E	60		19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net			23	1			71	3	2						
Otter Trawl	1		19	1			65	1	100 11				3		
Fish Community Season (Summer)															
1 Inch Trammel Net		N-E	23	2	N-E	N-E	70		5		N-E				
Mini-Fyke Net	1336		30 27				60 55	2 12	6 2				>1 1	2 3	
Otter Trawl	24		8 19	2			21 66		63 10				8 2		

Table 33. Total number of sand shiners captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net			100	N-E		
2.5 Inch Trammel Net			100			
Gill Net			58		42	
Otter Trawl	1		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net			100	N-E		
Mini-Fyke Net	1336	100 100				
Otter Trawl	24		100 100			

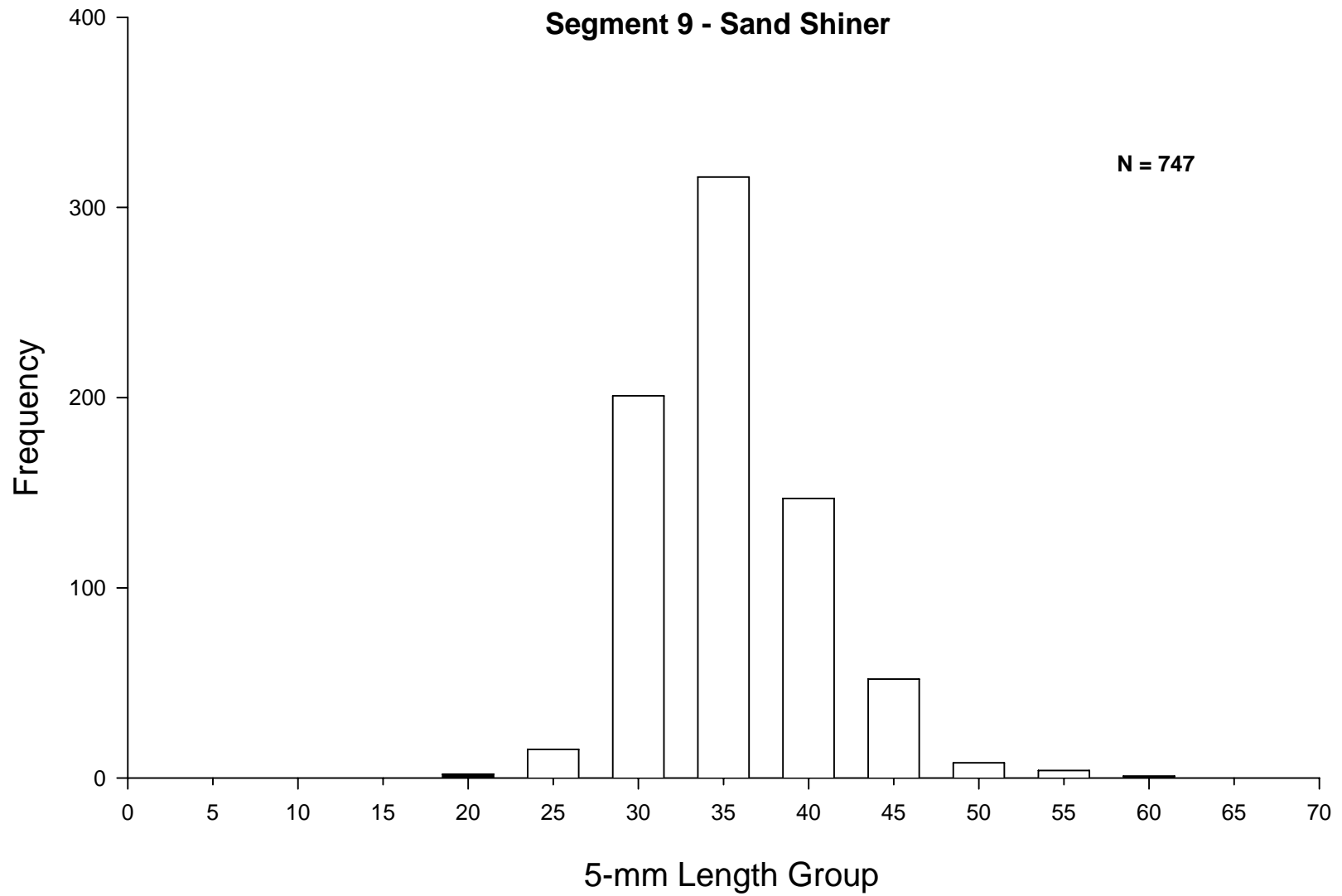


Figure 33. Length frequency of sand shiners during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 9 of the Missouri River during 2006.

***Hybognathus* spp.**

A total of 78 *Hybognathus* species were sampled during 2006 with 59 captured in standard gears and 19 in wild gears. Standard gears during 2006 included: mini-fyke nets (N = 58) and otter trawls (N = 1). Otter trawling remained an ineffective gear for sampling *Hybognathus* species. Fifty-eight *Hybognathus* species were collected while mini-fyke netting, resulting in a CPUE of 0.34 fish per net night (Figure 36). The 2005 CPUE was significantly different compared to 2003 ($\chi^2 = 4.42$, $P = 0.035$), 2004 ($\chi^2 = 12.14$, $P = 0.0005$) and 2006 ($\chi^2 = 27.28$, $P = < 0.0001$).

The majority of *Hybognathus* species (98%) were collected during the fish community season while mini-fyke nettings (N = 58). During the fish community season, 81% of the *Hybognathus* species were caught on inside bend macrohabitats while only 55% of the efforts was expended in this macrohabitat. *Hybognathus* species were more abundant in inside bend macrohabitats than predicted ($\chi^2 = 20.38$, $df = 5$, $P = 0.001$). All *Hybognathus* species were caught from bar mesohabitats during the fish community season for mini-fyke nets (Table 35).

A total of 78 *Hybognathus* species were measured during the 2005 fish community season (Figure 37). The average fork length was 34.7 mm. The length range for *Hybognathus* species was 16 to 67 mm.

Segment 9 - *Hybognathus* spp. / Fish Community Season

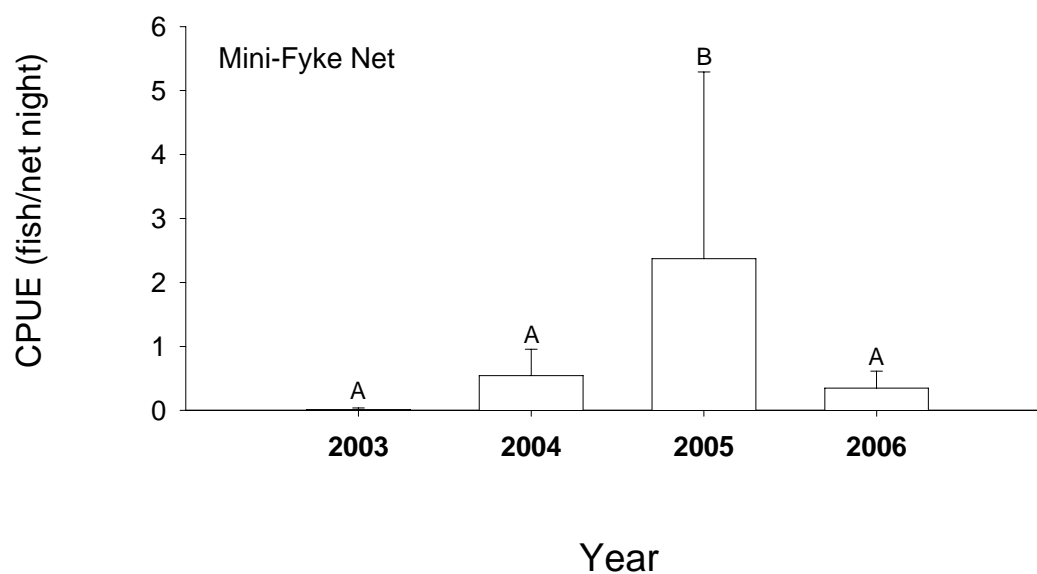


Figure 36. Mean annual catch-per-unit-effort (\pm 2SE) of *Hybognathus* spp. with mini-fyke nets in segment 9 of the Missouri River during fish community season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Table 34. Total number of *Hybognathus* spp. captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net		N-E	17	4	N-E	N-E	60		19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net			23	1			71	3	2						
Otter Trawl			19	1			65	1	11				3		
Fish Community Season (Summer)															
1 Inch Trammel Net		N-E	23	2	N-E	N-E	70		5		N-E				
Mini-Fyke Net	58		17 27				81 55	2 12	2				1	3	
Otter Trawl	1		19	2			66		100 10				2		

Table 35. Total number of *Hybognathus* spp. captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net			100	N-E		
2.5 Inch Trammel Net			100			
Gill Net			58		42	
Otter Trawl			100			
Fish Community Season (Summer)						
1 Inch Trammel Net			100	N-E		
Mini-Fyke Net	58	100 100				
Otter Trawl	1		100 100			

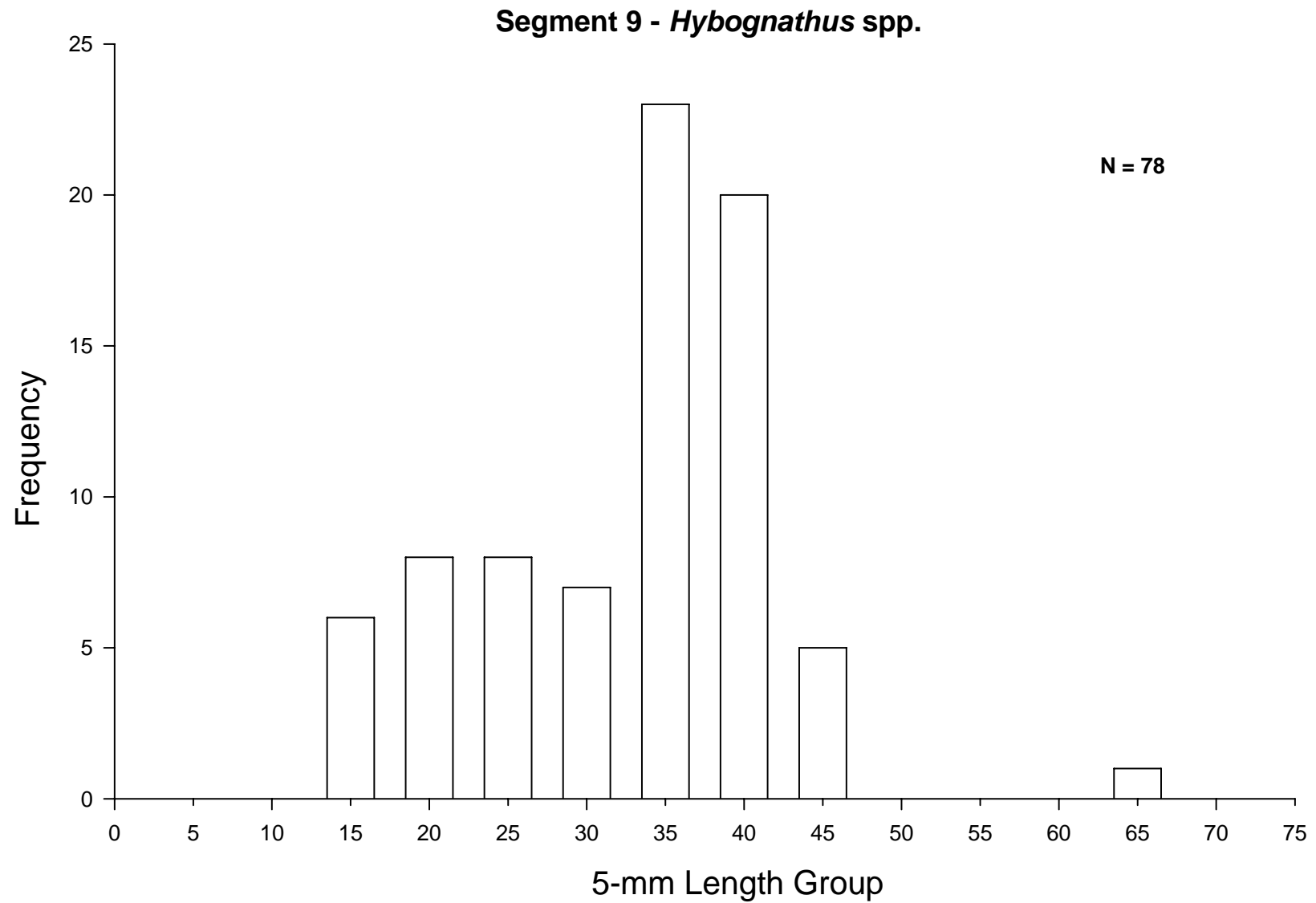


Figure 37. Length frequency of *Hybognathus* spp. caught during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 9 of the Missouri River during 2006.

Blue Sucker

A total of 682 blue suckers were sampled during 2006 with 617 captured in standard gears. Standard gears during 2006 included: 1.0" trammel nets (N = 303), 2.5" trammel nets (N = 130), gill nets (N = 97) and otter trawls (N = 50). During the sturgeon season, CPUE was highest for 1.0" trammel nets (0.70 fish per 100 m drifted) followed by 2.5" trammel nets (0.67 fish per 100m trawled) (Figures 38 and 39). Catch per unit effort for gill netting during the sturgeon season displays a significant difference between all years, except for 2003 versus 2006 ($\chi^2 = 6.78$, $P = 0.264$). One inch trammel nets during the sturgeon season continue to increase significantly ($\chi^2 = 54.94$, $P = < 0.0001$) while otter trawls and 2.5" trammel nets display no difference in mean annual catch rates ($\chi^2 = 6.71$, $df = 3$, $P = 0.081$ and $\chi^2 = 1.90$, $df = 1$, $P = 0.168$, respectively). Catch per unit effort trends for otter trawling during the fish community season increased significantly every year from 2003 ($\chi^2 = 11.38$, $P = 0.0007$) (Figure 41). Conversely, CPUE from 1.0" trammel nets has significantly decline during the fish community season since 2003 ($\chi^2 = 16.11$, $P = < 0.0001$).

Inside bend macrohabitats were the primary habitats sampled during both seasons and as expected, blue suckers were most frequently sampled from inside bend macrohabitats (Table 36). One inch trammel nets ($\chi^2 = 23.24$, $df = 3$, $P = 0.001$) and otter trawls ($\chi^2 = 14.95$, $df = 5$, $P = 0.011$) during the sturgeon season and 1.0" trammel nets ($\chi^2 = 13.14$, $df = 3$, $P = 0.004$) during the fish community season displayed a significant difference between number of fish caught and amount of effort within macrohabitats. The majority of blue suckers were sampled on channel border mesohabitats during both seasons with all gears (Table 37).

A total of 682 blue suckers were measured during 2006, with 425 being sampled during the sturgeon season (Figure 44). The average fork length was 665.5 mm during the sturgeon season compared to 639.4 mm for the fish community season. The distribution between the two seasons were not significantly different ($D = 0.26$, $P = 0.108$). The length range for blue suckers sampled during the sturgeon season was 253 to 858 mm compared to 72 to 834 mm for the fish community season.

Segment 9 - Blue Sucker / Sturgeon Season

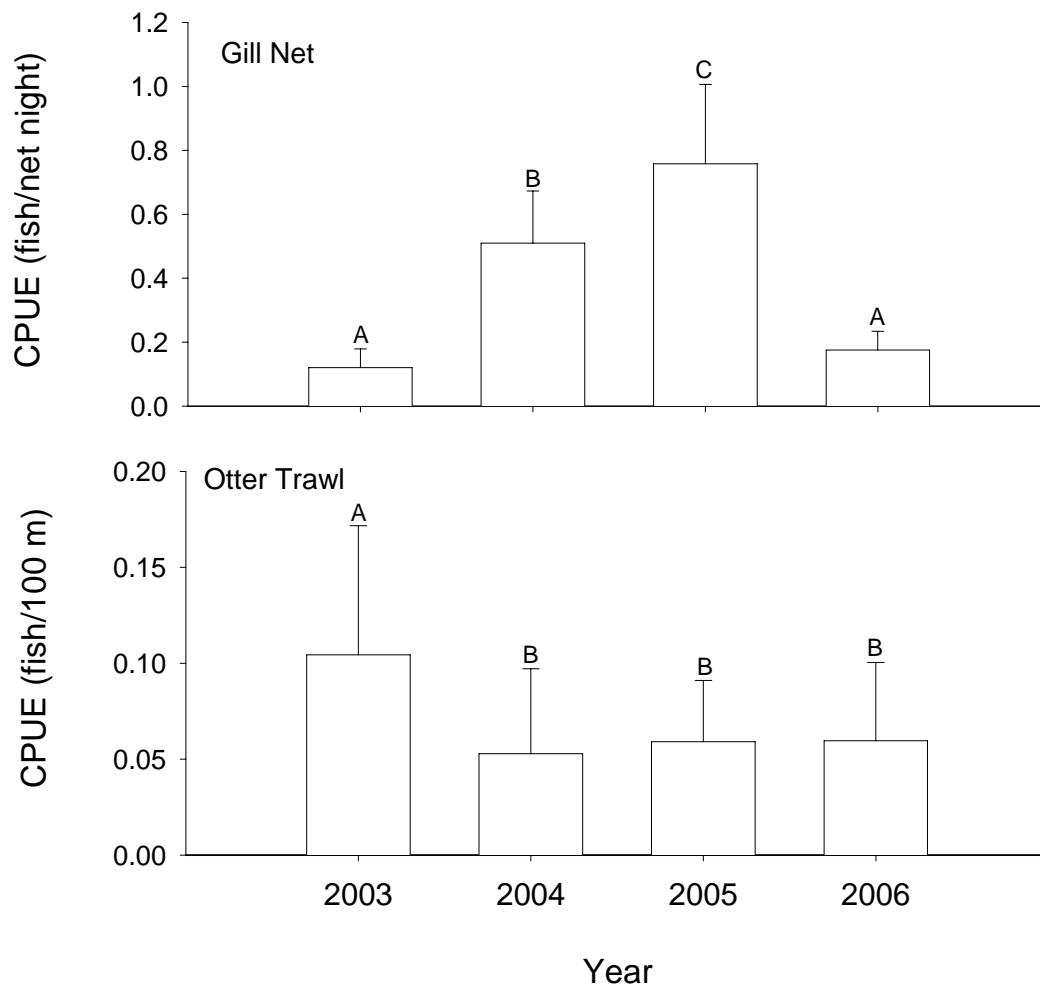


Figure 38. Mean annual catch-per-unit-effort (\pm 2SE) of blue sucker with gill nets and otter trawls in segment 9 of the Missouri River during sturgeon season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Blue Sucker / Sturgeon Season

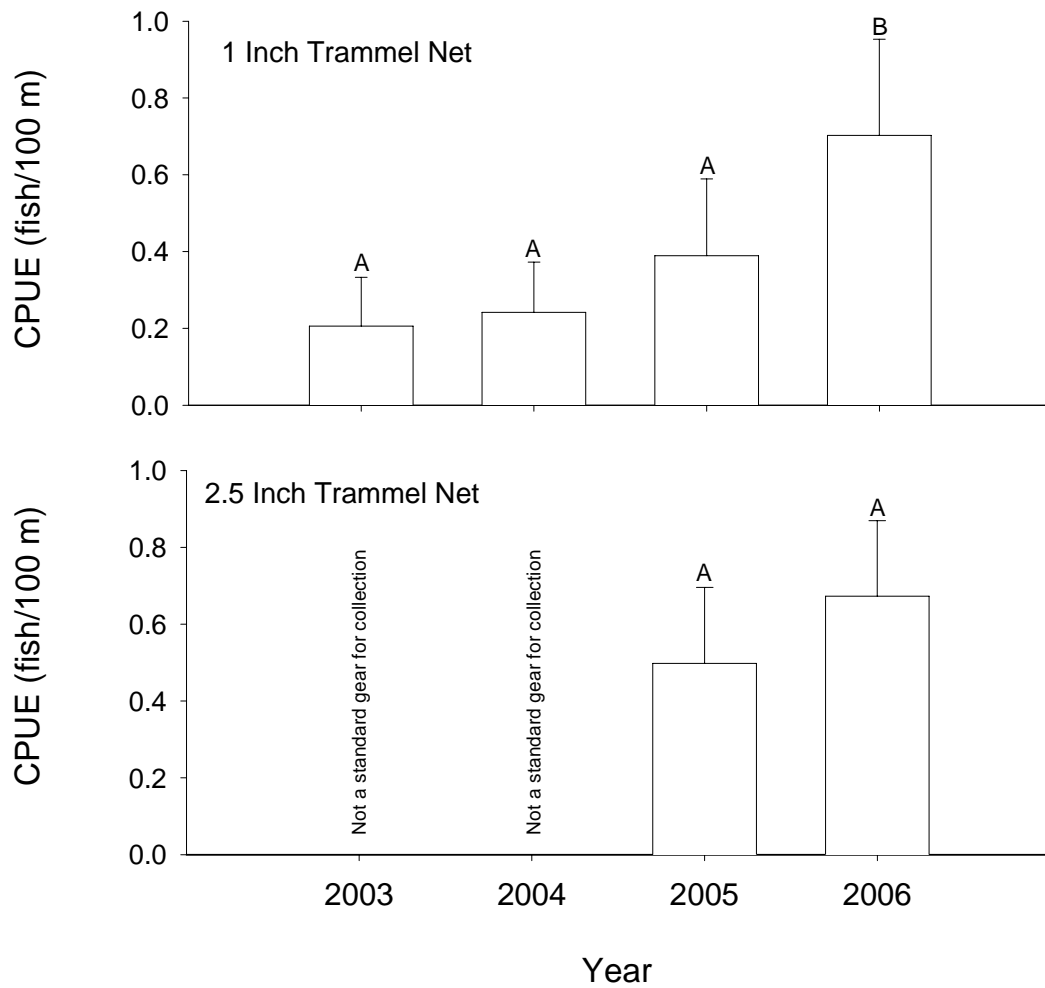


Figure 39. Mean annual catch-per-unit-effort ($\pm 2SE$) of blue sucker with 1 and 2.5 inch trammel nets in segment 9 of the Missouri River during sturgeon season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Blue Sucker / Fish Community Season

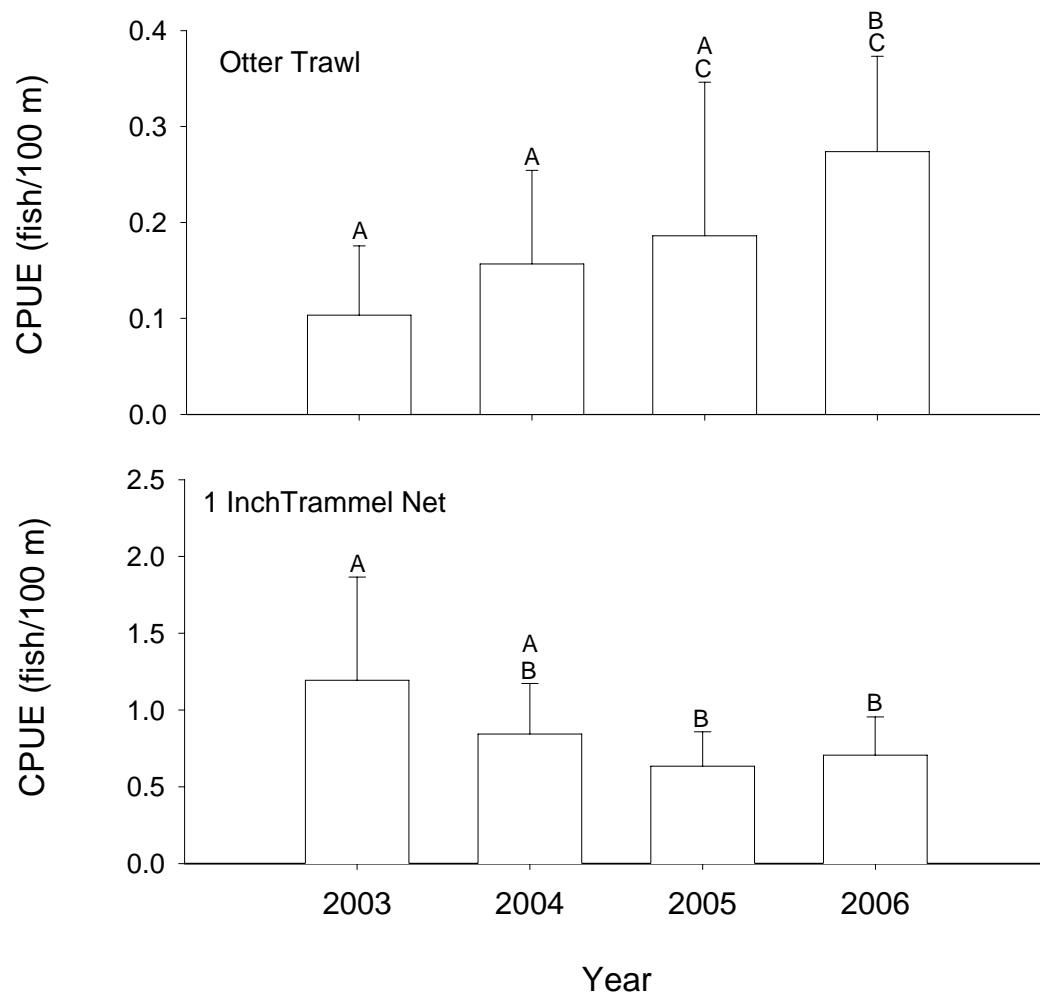


Figure 41. Mean annual catch-per-unit-effort ($\pm 2SE$) of blue sucker using otter trawls and 1 inch trammel nets in segment 9 of the Missouri River during fish community season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Table 36. Total number of blue suckers captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	169	N-E	7 17	1 4	N-E	N-E	89 60		3 19		N-E				
2.5 Inch Trammel Net	130		12 24	2 1			83 72		3 3						
Gill Net	97		20 23	 1			67 71	4 3	9 2						
Otter Trawl	12		17 19	8 1			50 65	 1	25 11				3		
Fish Community Season (Summer)															
1 Inch Trammel Net	134	N-E	7 23	2	N-E	N-E	90 70		4 5		N-E				
Mini-Fyke Net			27				55	12	2				1	3	
Otter Trawl	75		15 19	4 2			71 66		9 10				1 2		

Table 37. Total number of blue suckers captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	169		100 100	N-E		
2.5 Inch Trammel Net	130		100 100			
Gill Net	97		53 58		47 42	
Otter Trawl	12		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net	134		100 100	N-E		
Mini-Fyke Net		100				
Otter Trawl	75		100 100			

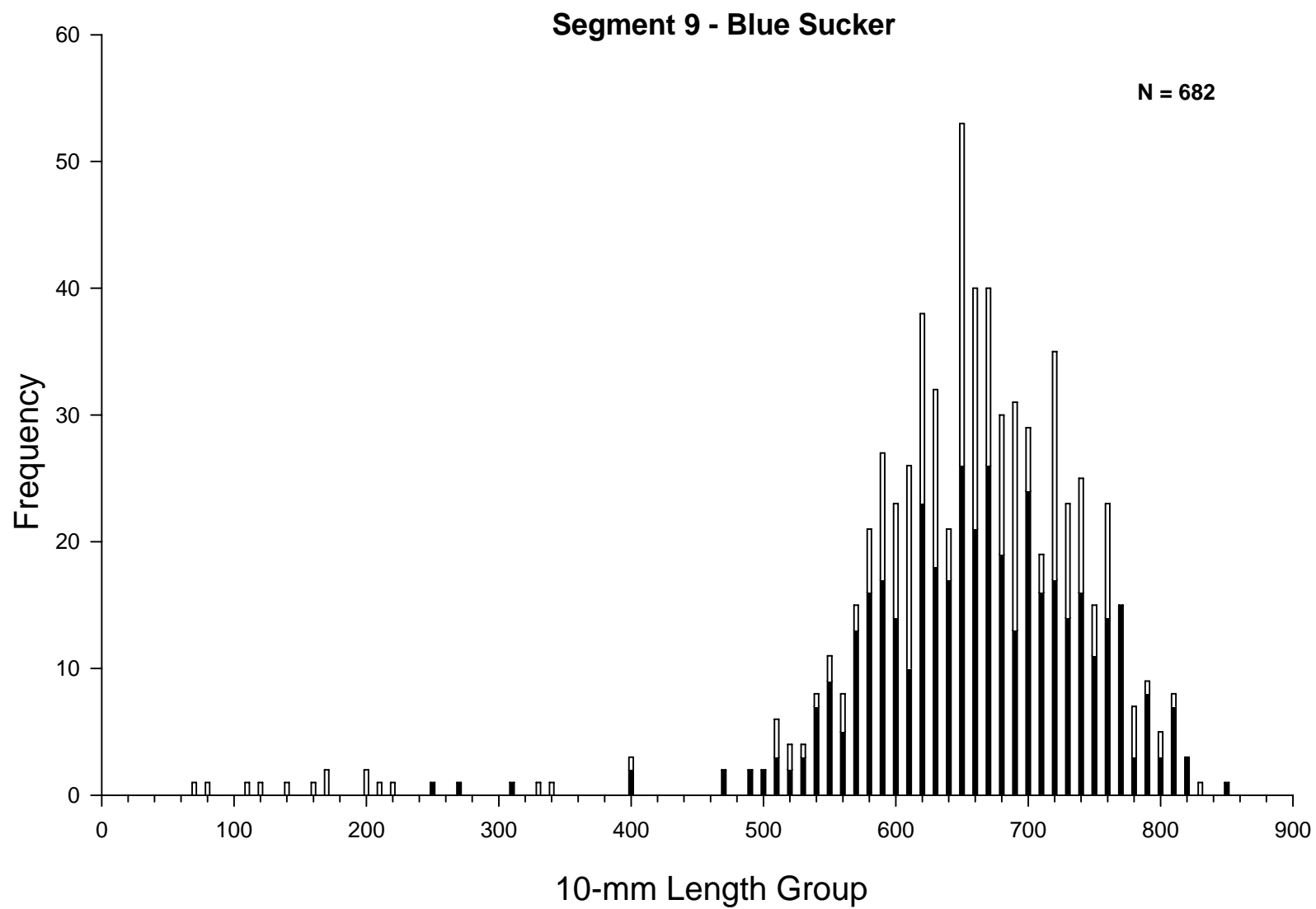


Figure 44. Length frequency of blue suckers during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 9 of the Missouri River during 2006.

Sauger

A total of 146 sauger were sampled during 2006 with 137 captured in standard gears. Standard gears during 2006 included: gill nets (N = 92), otter trawls (N = 22), mini-fyke net (N = 13) and 1.0" trammel nets (N = 10). Catch per unit effort increased for all gears during the 2006 sturgeon season compared to 2004 and 2005. Catch rates for gill nets during the sturgeon season have significantly increased every year since 2003 ($\chi^2 = 16.14$, $P = < 0.0001$) (Figure 45). Thirteen sauger were collected while otter trawling and seven were collected while trammel netting during the sturgeon season, resulting in a CPUE of 0.04 fish per 100 m trawled and 0.02 fish per 100 m drifted, respectively. No sauger were sampled with the 2.5" trammel nets (Figure 46).

Mean annual CPUE for the 2006 fish community season displayed similar trends as the sturgeon season. Catch per unit effort for otter trawling increased to 0.03 fish per 100 m trawled compared to 0.004 fish per 100 m trawled during 2005 (Figure 48). One inch trammel nets during the fish community season collected three sauger, resulting in a CPUE of 0.02 fish per 100 m drifted. Mini-fyke net CPUE increased to 0.08 fish per net night in 2006 from 0.02 in 2005 (Figure 49).

Sauger were most frequently sampled during the sturgeon and fish community seasons from inside bend macrohabitats (Table 38). Gill netting during the sturgeon season did not significantly differ between number of fish caught and amount of effort expended within macrohabitats ($\chi^2 = 9.23$, $df = 4$, $P = 0.055$). However, there was a significant difference when comparing the mesohabitats ($\chi^2 = 13.65$, $df = 1$, $P = 0.001$). Sixty-eight percent of Sauger were sampled in pool mesohabitats with only 42% of effort being expended (Table 39). Conversely, 32% were sampled in channel border mesohabitat with 58% of the effort. Due to where the gears are deployed, all sauger were collected from channel border mesohabitats with trammel nets and otter trawls and bar mesohabitats while using mini-fyke nets.

A total of 146 sauger were measured during 2006, with 113 being sampled during the sturgeon season (Figure 51). The average fork length was 371.3 mm during the sturgeon season compared to 187.7 mm for the fish community season. The distribution between the two season were significantly different ($D = 0.44$, $P = 0.04$). The length range for sauger sampled during the sturgeon season was 66 to 448 mm compared to 38 to 564 mm for the fish community season.

Segment 9 - Sauger / Sturgeon Season

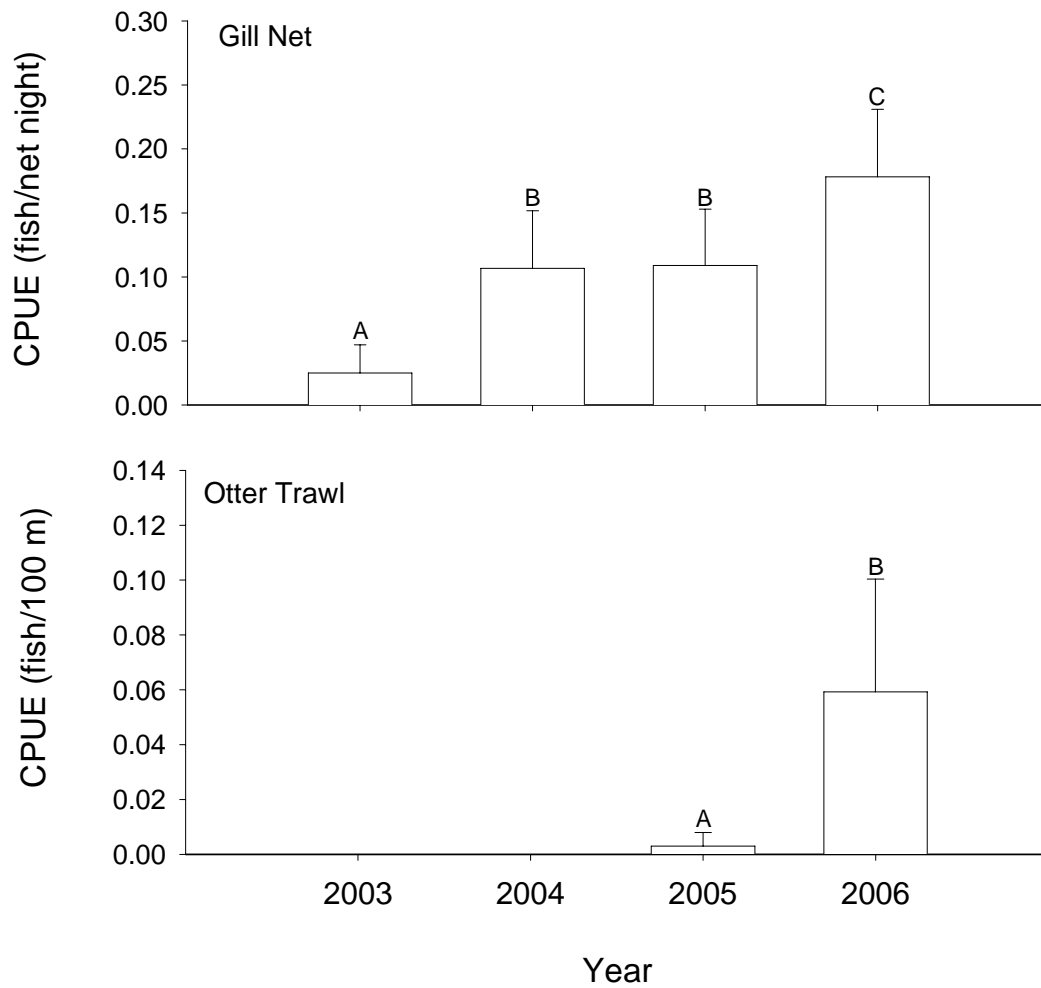


Figure 45. Mean annual catch-per-unit-effort (± 2 SE) of sauger using gill nets and otter trawls in segment 9 of the Missouri River during sturgeon season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Sauger / Sturgeon Season

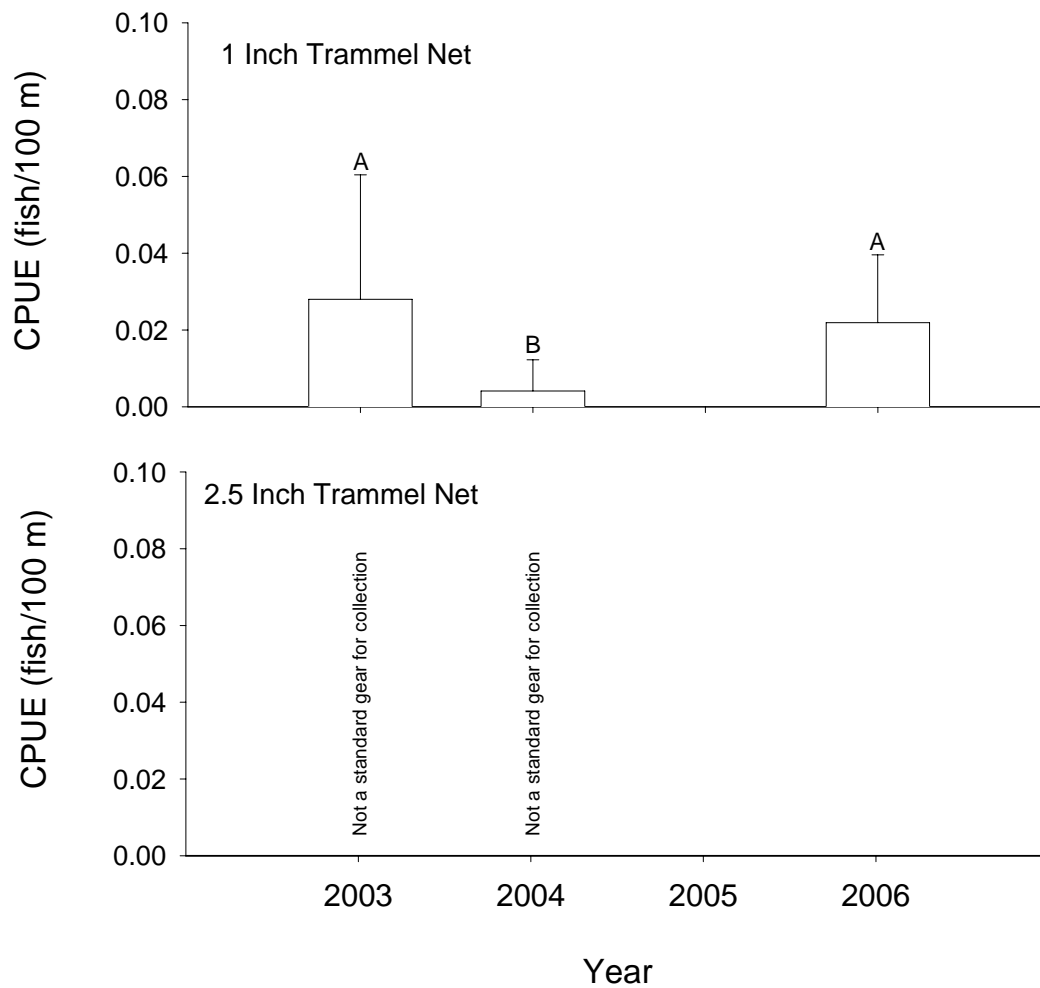


Figure 46. Mean annual catch-per-unit-effort ($\pm 2SE$) of sauger using 1 and 2.5 inch trammel nets in segment 9 of the Missouri River during sturgeon season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Sauger / Fish Community Season

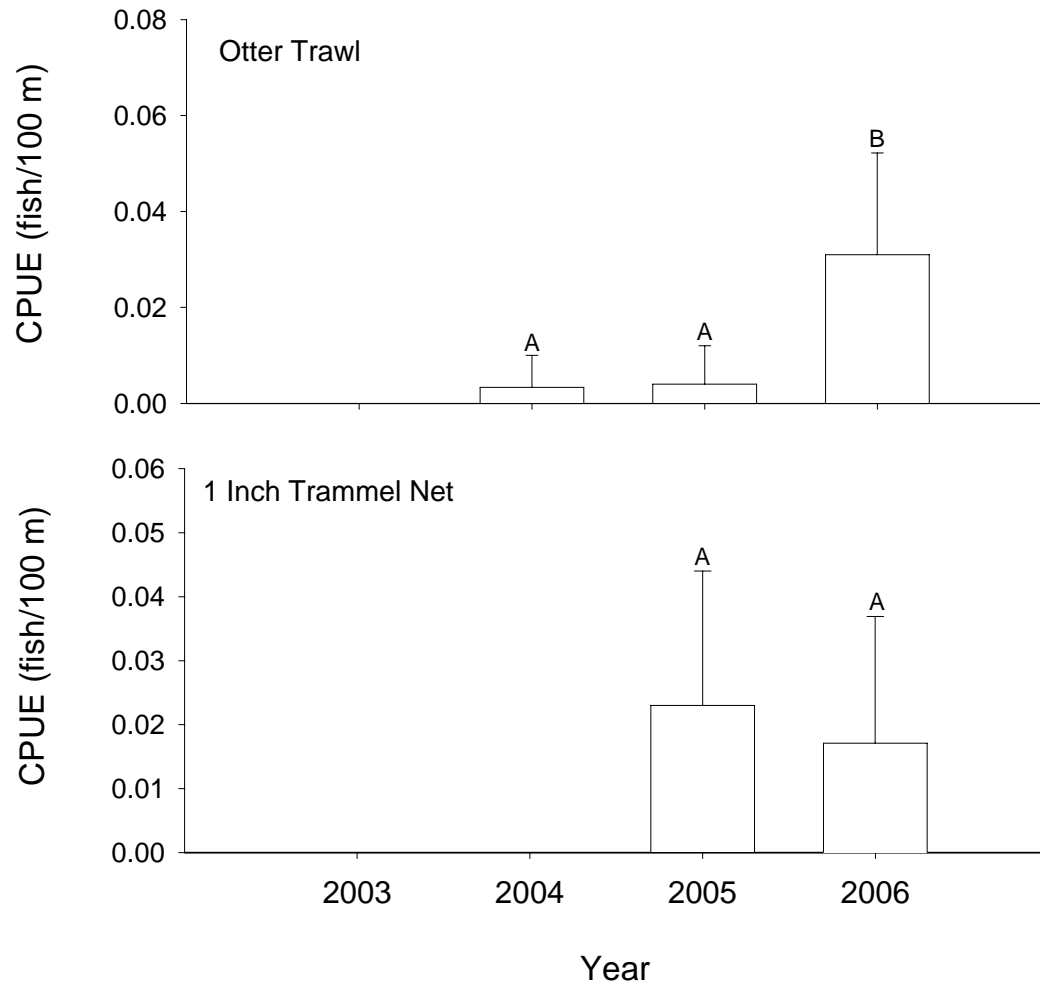


Figure 48. Mean annual catch-per-unit-effort ($\pm 2SE$) of sauger using otter trawls and 1 inch trammel nets in segment 9 of the Missouri River during fish community season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Segment 9 - Sauger / Fish Community Season

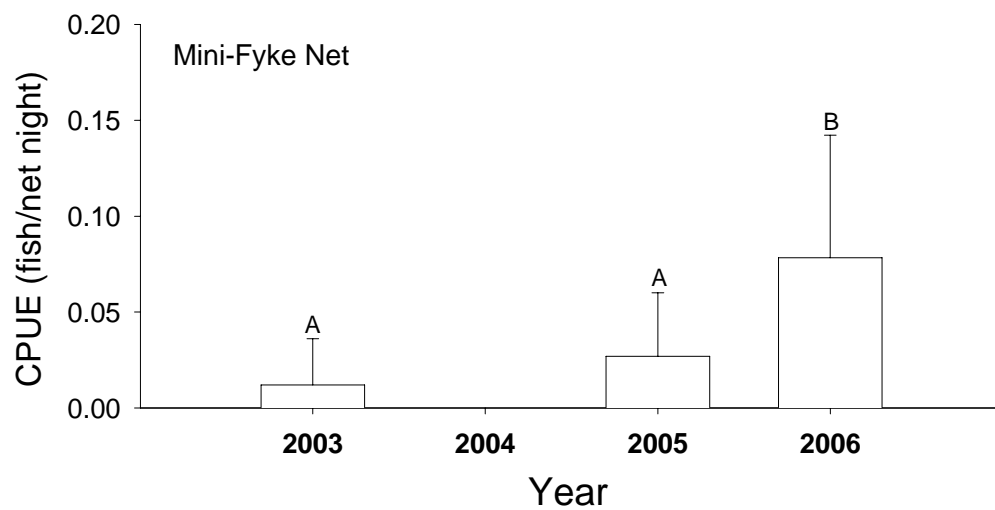


Figure 49. Mean annual catch-per-unit-effort ($\pm 2SE$) of sauger using mini-fyke nets in segment 9 of the Missouri River during fish community season 2003 - 2006. Letters denote a significant difference in yearly comparisons.

Table 38. Total number of saugers captured for each gear during each season and the proportion caught within each macrohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Macrohabitat													
		BRAD	CHXO	CONF	DEND	DRNG	ISB	OSB	SCCL	SCCS	SCCN	TRIB	TRML	TRMS	WILD
Sturgeon Season (Fall through Spring)															
1 Inch Trammel Net	7	N-E	17	4	N-E	N-E	71 60		29 19		N-E				
2.5 Inch Trammel Net			24	1			72		3						
Gill Net	92		27 23	8 1			63 71	1 3	2						
Otter Trawl	13		8 19	1			46 65	1	38 11				8 3		
Fish Community Season (Summer)															
1 Inch Trammel Net	3	N-E	23	2	N-E	N-E	100 70		5		N-E				
Mini-Fyke Net	13		15 27				85 55	12	2				1	3	
Otter Trawl	9		22 19	2			78 66		10				2		

Table 39. Total number of saugers captured for each gear during each season and the proportion caught within each mesohabitat type in segment 9 of the Missouri River during 2006. The percent of total effort for each gear in each habitat is presented on the second line of each gear type. N-E indicates the habitat is non-existent in the segment.

Gear	N	Mesohabitat				
		BARS	CHNB	ITIP	POOL	TLWG
Sturgeon Season (Fall through Spring)						
1 Inch Trammel Net	7		100 100	N-E		
2.5 Inch Trammel Net			100			
Gill Net	92		32 58		68 42	
Otter Trawl	13		100 100			
Fish Community Season (Summer)						
1 Inch Trammel Net	3		100 100	N-E		
Mini-Fyke Net	13	100 100				
Otter Trawl	9		100 100			

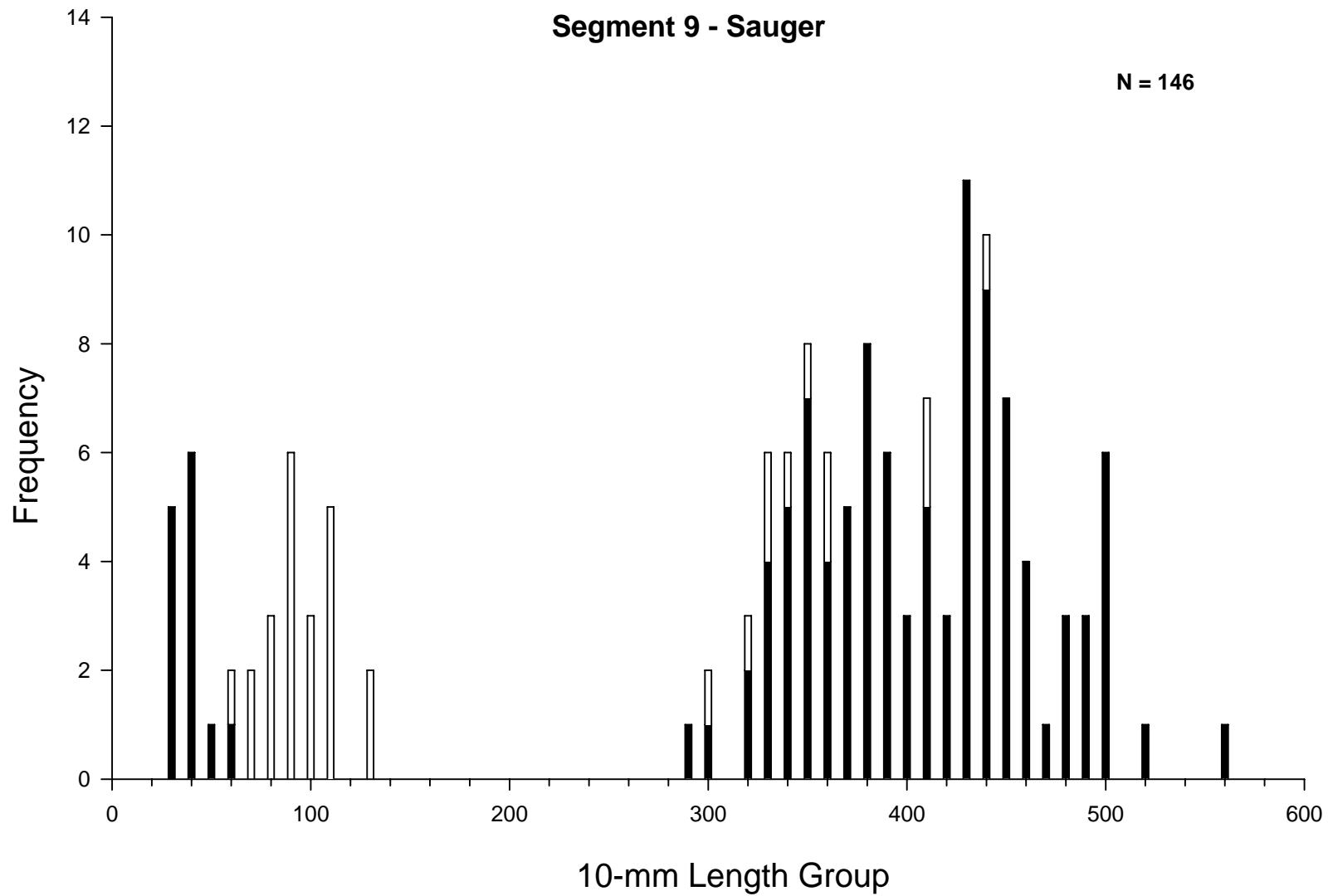


Figure 51. Length frequency of sauger during fall through spring (sturgeon season, black bars) and summer (fish community season, white bars) in segment 9 of the Missouri River during 2006.

Missouri River Fish Community

A total of 30,548 fish were captured in segment 9 of the Missouri River using standard gears. These gears collected 69 species with emerald shiners (29.9%, N = 9,140), red shiners (11.8%, N = 3,627) and shovelnose sturgeon (10.8%, N = 3,291) making up over 50% of the total catch. Target species account for 19.7% of the total catch, contributing in the follow order of relative abundance: shovelnose sturgeon (N = 3,291), sand shiners (N = 1,361), blue suckers (N = 617), speckled chubs (N = 348), sicklefin chubs (N = 166), sauger (N = 137), sturgeon chubs (N = 115), *Hybonathus* species (N = 59) and pallid sturgeon (N = 30).

Gill nets remain the most productive gear for capturing large bodied fish. The 2006 effort increased by 212 net nights but only 150 more fish were collected, compared to 2005 (Steffensen and Barada, 2006). The 2006 effort resulted in a total mean CPUE of 6.1 fish per net night (Appendix F1 and H). During 2006, shovelnose sturgeon were the most frequently captured species with a CPUE of 3.4 fish per net night, followed by goldeye (1.4 fish per net night). All other species were sampled at a frequency of less then 0.35 fish per net night.

During the 2006 sturgeon season, a total of 982 fish representing 22 species were captured in 27,930 meters of drifting trammel nets (CPUE = 3.5 fish per 100 m drifted). Compared to the fish community season when a total of 534 fish representing 22 species were captured in 20,790 meters of drifting trammel nets (CPUE = 2.6 fish per 100 m drifted). Shovelnose sturgeon were the most frequently captured species with a CPUE of 1.5 fish per 100 m drifted, followed by blue suckers (0.7 fish per 100 m drifted) (Appendix F2). All other species were sampled at a frequency of less then 0.2 fish per 100 m drifted.

Initially designed to capture large *Scaphirhynchus* species during the sturgeon season, the 2.5" trammel net will be eliminated as a standard sampling gear in 2007. It was determined that the catch from the 2.5" trammel net was not significantly different than the catch from the 1.0" trammel net (Steffensen and Hamel, unpublished data). In 2006, a total of 274 fish representing 16 species were captured in 19,530 meters of drifting trammel nets (CPUE = 1.4 fish per 100 m drifted) (Appendix F3). Blue suckers were the most frequently capture species with a CPUE of 0.67 fish per 100 m drifted, followed by shovelnose sturgeon (CPUE = 0.35 fish per 100 m drifted) and smallmouth buffalo (CPUE = 0.12 fish per 100 m drifted).

Otter trawls are the most productive method for the collection of all sized fishes. During the 2006 sturgeon season, a total of 1,741 fish representing 32 species were captures in 24,780 meters of trawling (CPUE = 7.0 fish per 100 m trawled). Compared to the fish community

season when a total of 4,892 fish representing 41 species were captured in 37,170 meters of trawling (CPUE = 13.2 fish per 100 m trawled). Freshwater drum were the most frequently captured species with a CPUE of 2.5 fish per 100 m trawled, followed by channel catfish (2.2 fish per 100 m trawled) and shovelnose sturgeon (0.7 fish per 100 m trawled) (Appendix F4). All other species were sampled at a frequency of less than 0.6 fish per 100 m trawled.

Mini-fyke nets remain the most productive gear to collect small bodied fishes and catch the greatest diverse of fish species. In 2006, a total of 18,557 fish representing 52 species were captured in 166 net nights (CPUE = 111.3 fish per net night). This was a substantial increase over the previous year. In 2005, a total of 8,433 fish representing 56 were captured in 146 net nights (CPUE = 57.8 fish per net night). During 2006, emerald shiners were the most frequently captured species with a CPUE of 55.6 fish per net night, followed by red shiners (21.4 fish per net night) and sand shiners (8.0 fish per net night) (Appendix F6).

Discussion

Pallid Sturgeon

Thirty-one pallid sturgeon were collected during the 2006 sampling season in segment 9 of the Missouri River (Figure 1b). Gill nets remain the most effective gear for capturing pallid sturgeon, collecting fifteen pallid sturgeon (9 hatchery reared and 6 unknowns) (Appendix F1). Pre-winter gill netting produced only two pallid sturgeon compared to 13 during post winter gill netting. Trammel nets and otter trawls had been fairly ineffective from 2003 to 2005, sampling only 12 pallid sturgeon in over 200 kilometers of effort (Figures 2, 3 and 5). However, trammel netting and otter trawling produced 15 pallid sturgeon during 2006 (Figures 2, 3 and 5). Pallid sturgeon were captured in two continuous macrohabitats (inside bend and channel cross-over) with the majority being collected on inside bends (Tables 9 and 11). Tributary confluence, secondary channel connected large and tributary mouth large were the only discrete macrohabitats where pallid sturgeon were collected (Tables 9 and 11). Pallid sturgeon were sampled in locations with a mean water depth of 2.4 m and an average bottom velocity of 0.54 mps (Table 3). Pallid sturgeon collected during winter gill netting were collected in deeper water and slower water velocities compared to trammel nets and otter trawls (depth: 2.7 m vs. 2.1 m, water velocity: 0.47 mps vs. 0.59 mps).

Over 15,000 hatchery reared pallid sturgeon have been stocked in segment 9 since 1997 (Appendix E). Hatchery reared pallid sturgeon stocked into segment 9 were representatives of the 1992, 1997, 2003, 2004 and 2005 year classes. During the 2006 sampling season, four year classes were recaptured (2001, 2002, 2003 and 2005) (Table 6).

Shovelnose Sturgeon

Gill nets remained the most effective sampling method for shovelnose sturgeon, collecting almost 59% of all shovelnose sturgeon during 2006 (Table 17 – 24). However, there has been a sharp decline in CPUE from 2003 (12.0 fish per net night), 2004 (CPUE = 6.9) and 2005 (CPUE = 7.3) compared to 2006 (CPUE = 3.4) (Figure 11). The decline in CPUE from 2003 compared to 2004 to 2006 can be attributed to the fact that during the 2003 sampling season gill nets were set exclusively in pool mesohabitats. Whereas sampling efforts for the 2004 to 2006 sampling seasons were divided into pool and channel border mesohabitats. One inch trammel nets were the second most effective gear for sampling shovelnose sturgeon (N = 809), sampling over twice as many compared to otter trawling (N = 403) (Figures 11, 12 and 14). We have observed that drifting trammel nets outside of wing dike tips produce lower catch rates

and higher number of damaged or lost nets. A seventy-five meter drift between wing dikes is not always possible in this reach of the Missouri River due to wing dike spacing and placement.

Macrophybopsis species

Otter trawling remained the most effective standard sampling method for all *Macrophybopsis* species. Otter trawling collected 113 of 115 sturgeon chubs, all sicklefin chubs and 346 of 348 speckled chubs throughout both seasons (Appendix F4). However, the use of an experimental small mesh otter trawl proved very effective at capturing these species (Steffensen and Hamel, unpublished data). The experimental trawl collected 527 speckled chubs, 186 sturgeon chubs and 95 sicklefin chubs.

Sand Shiners

Mini-fyke nets remain the most effective method to collect sand shiners, collecting over 98% of the total catch (Appendix F6). Overall catch rate for sand shiners has increased each year since 2003 (Figures 30, 31 and 32).

Hybognathus species

Mini-fyke nets remain the most effective method from collecting *Hybognathus* species (Appendix F6). Overall catch for *Hybognathus* species decreased during 2006 (N = 59) compared to 2005 (N = 388), 2004 (N = 222) and 2003 (N = 1,185) (Figure 36). This can be attributed to bag seines being removed as a standard gear for the 2006 sampling season (Travnichek, unpublished data).

Blue Sucker

Trammel nets were the most effective sampling method for blue suckers, collecting almost 50% of all blue suckers sampled during 2006 (Appendix F2). This differed when compared to the 2004 and 2005 sampling season when hoop nets and gill nets were the most effective gears, respectively (Steffensen and Barada, 2006 and Steffensen and Mestl, 2005). Overall catch for blue suckers increased during 2006 (N = 617) compared to 2005 (N = 552), 2004 (N = 474) and 2003 (N = 240).

Sauger

More sauger were collected during the 2006 (N = 137) sampling season than the first three years of this project (N = 105) (Steffensen and Barada, 2006). Winter gill netting in wing dike pools remain the most productive method for collecting sauger (Figure 45).

Miscellaneous Work

Beside the completion of the required contractual work, the Nebraska Game and Parks Commission Pallid Sturgeon Assessment (PSA) Crew also participate in several side projects.

During late April, Tony Barada and Kirk Steffensen attended the annual project training at the confluence of the Yellowstone and Missouri Rivers. A Missouri River channelized crew training was then attended during mid-May by the entire NGPC PSA crew.

The NGPC PSA crew assisted the United States Geological Service (USGS) with the collection of blood and egg samples from gravid shovelnose sturgeon. Eggs were extracted from 5 fish per week and a blood sample was taken from 20 individual fish per week. These samples were then processed and shipped to USGS Columbia for analysis. Also in coordination with the USGS, the MDC and NGPC PSA crews marked shovelnose sturgeon with floy tags. Almost 2,200 shovelnose sturgeon were marked and 45 tagged fish were recollected.

After the standardize sampling had been completed, the PSA crew participated in three gear evaluations. An experimental small mesh otter trawl was developed and evaluated in an attempt to collect additional information on small bodied fishes, especially small *Scaphirhynchus* species. The results of the experimental otter trawl are pending. A gear avoidance study using green dyed and white trammel and gill nets was also completed. The NGPC PSA crew participated by drifting white and green trammel nets on 21 bends at 4 sub-samples per bend. The results of this experiment are pending. An independent gear assessment was also completed to compare stern and bow trawling. The standard OT16 was used in two different trawling configuration on 21 bends at 4 sub-samples per bend. The results of this experiment are pending.

Assistance was also provided to Ben Neely, a graduate student at the University of Nebraska in Lincoln. Mr. Neely is doing a telemetry study on blue suckers in the Missouri River. Fish were collected and transported to Gavin's Point Hatchery and Aksarben Aquarium for a preliminary tag retention study.

Travis Kueter and Tony Barada provided Missouri River tours of the newly constructed Ponca backwater during the Ponca State Park Outdoor Expo. Travis Kueter, Ryan Ruskamp, Tony Barada, Bill Garvey and Josh Wilhelm provided boats and assistance during the Omaha river front clean-up efforts.

The Nebraska Game and Parks Commission hosted the 67th Midwest Fish and Wildlife Conference in Omaha during December. The entire crew provided technical assistance with the audio/visual equipment and the cyber café during the conference sessions.

Finally, fish were collected and transported for the Nebraska's State Fair and for the new Cabela's in La Vista, Nebraska.

Acknowledgments

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APPENDICES

Appendix A. Phylogenetic list of Missouri River fishes with corresponding letter codes used in the long-term pallid sturgeon and associated fish community sampling program. The phylogeny follows that used by the American Fisheries Society, Common and Scientific Names of Fishes from the United States and Canada, 5th edition. Asterisks and bold type denote targeted native Missouri River species.

Scientific name	Common name	Letter Code
CLASS CEPHALASPIDOMORPHI-LAMPREYS		
ORDER PETROMYZONTIFORMES		
Petromyzontidae – lampreys		
<i>Ichthyomyzon castaneus</i>	Chestnut lamprey	CNLP
<i>Ichthyomyzon fossor</i>	Northern brook lamprey	NBLP
<i>Ichthyomyzon unicuspis</i>	Silver lamprey	SVLP
<i>Ichthyomyzon gagei</i>	Southern brook lamprey	SBLR
Petromyzontidae	Unidentified lamprey	ULY
Petromyzontidae larvae	Unidentified larval lamprey	LVLP
CLASS OSTEICHTHYES – BONY FISHES		
ORDER ACIPENSERIFORMES		
Acipenseridae – sturgeons		
<i>Acipenser fulvescens</i>	Lake sturgeon	LKSG
<i>Scaphirhynchus</i> spp.	Unidentified Scaphirhynchus	USG
<i>Scaphirhynchus albus</i>	Pallid sturgeon	PDSG*
<i>Scaphirhynchus platyrhynchus</i>	Shovelnose sturgeon	SNSG*
<i>S. albus</i> X <i>S. platyrhynchus</i>	Pallid-shovelnose hybrid	SNPD
Polyodontidae – paddlefishes		
<i>Polyodon spathula</i>	Paddlefish	PDFH
ORDER LEPISOSTEIFORMES		
Lepisosteidae – gars		
<i>Lepisosteus oculatus</i>	Spotted gar	STGR
<i>Lepisosteus osseus</i>	Longnose gar	LNGR
<i>Lepisosteus platostomus</i>	Shortnose gar	SNGR
ORDER AMMIFORMES		
Amiidae – bowfins		
<i>Amia calva</i>	Bowfin	BWFN
ORDER OSTEOGLOSSIFORMES		
Hiodontidae – mooneyes		
<i>Hiodon alosoides</i>	Goldeye	GDEY
<i>Hiodon tergisus</i>	Mooneye	MNEY
ORDER ANGUILLIFORMES		
Anguillidae – freshwater eels		
<i>Anguilla rostrata</i>	American eel	AMEL

Appendix A. (continued).

Scientific name	Common name	Letter Code
ORDER CLUPEIFORMES		
Clupeidae – herrings		
<i>Alosa alabame</i>	Alabama shad	ALSD
<i>Alosa chrysochloris</i>	Skipjack herring	SJHR
<i>Alosa pseudoharengus</i>	Alewife	ALWF
<i>Dorosoma cepedianum</i>	Gizzard shad	GZSD
<i>Dorosoma petenense</i>	Threadfin shad	TFSD
<i>D. cepedianum</i> X <i>D. petenense</i>	Gizzard-threadfin shad hybrid	GSTS
ORDER CYPRINIFORMES		
Cyprinidae – carps and minnows		
<i>Campostoma anomalum</i>	Central stoneroller	CLSR
<i>Campostoma oligolepis</i>	Largescale stoneroller	LSSR
<i>Carassius auratus</i>	Goldfish	GDFH
<i>Carassius auratus</i> X <i>Cyprinus carpio</i>	Goldfish-Common carp hybrid	GFCC
<i>Couesius plumbeus</i>	Lake chub	LKCB
<i>Ctenopharyngodon idella</i>	Grass carp	GSCP
<i>Cyprinella lutrensis</i>	Red shiner	RDSN
<i>Cyprinella spiloptera</i>	Spotfin shiner	SFSN
<i>Cyprinus carpio</i>	Common carp	CARP
<i>Erimystax x-punctatus</i>	Gravel chub	GVCB
<i>Hybognathus argyritus</i>	Western silvery minnow	WSMN*
<i>Hybognathus hankinsoni</i>	Brassy minnow	BSMN
<i>Hybognathus nuchalis</i>	Mississippi silvery minnow	SVMW
<i>Hybognathus placitus</i>	Plains minnow	PNMW*
<i>Hybognathus</i> spp.	Unidentified <i>Hybognathus</i>	HBNS
<i>Hypophthalmichthys molitrix</i>	Silver carp	SVCP
<i>Hypophthalmichthys nobilis</i>	Bighead carp	BHCP
<i>Luxilus chrysocephalus</i>	Striped shiner	SPSN
<i>Luxilus cornutus</i>	Common shiner	CMSN
<i>Luxilus zonatus</i>	Bleeding shiner	BDSN
<i>Lythrurus unbratilis</i>	Western redfin shiner	WRFS
<i>Macrhybopsis aestivalis</i>	Speckled chub	SKCB*
<i>Macrhybopsis gelida</i>	Sturgeon chub	SGCB*
<i>Macrhybopsis meeki</i>	Sicklefin chub	SFCB*
<i>Macrhybopsis storeriana</i>	Silver chub	SVCB
<i>M. aestivalis</i> X <i>M. gelida</i>	Speckled-Sturgeon chub hybrid	SPST
<i>M. gelida</i> X <i>M. meeki</i>	Sturgeon-Sicklefin chub hybrid	SCSC
<i>Macrhybopsis</i> spp.	Unidentified chub	UHY
<i>Margariscus margarita</i>	Pearl dace	PLDC
<i>Mylocheilus caurinus</i>	Peamouth	PEMT
<i>Nocomis biguttatus</i>	Hornyhead chub	HHCB
<i>Notemigonus crysoleucas</i>	Golden shiner	GDSN
<i>Notropis atherinoides</i>	Emerald shiner	ERSN
<i>Notropis blennioides</i>	River shiner	RVSN
<i>Notropis boops</i>	Bigeye shiner	BESN
<i>Notropis burchanani</i>	Ghost shiner	GTSN
<i>Notropis dorsalis</i>	Bigmouth shiner	BMSN
<i>Notropis greeni</i>	Wedgespot shiner	WSSN

Appendix A. (continued).

Scientific name	Common name	Letter Code
Cyprinidae – carps and minnows		
<i>Notropis heterolepsis</i>	Blacknose shiner	BNSN
<i>Notropis hudsonius</i>	Spottail shiner	STSN
<i>Notropis nubilus</i>	Ozark minnow	OZMW
<i>Notropis rubellus</i>	Rosyface shiner	RYSN
<i>Notropis shumardi</i>	Silverband shiner	SBSN
<i>Notropis stilbius</i>	Silverstripe shiner	SSPS
<i>Notropis stramineus</i>	Sand shiner	SNSN*
<i>Notropis topeka</i>	Topeka shiner	TPSN
<i>Notropis volucellus</i>	Mimic shiner	MMSN
<i>Notropis wickliffi</i>	Channel shiner	CNSN
<i>Notropis</i> spp.	Unidentified shiner	UNO
<i>Opsopoeodus emiliae</i>	Pugnose minnow	PNMW
<i>Phenacobius mirabilis</i>	Suckermouth minnow	SMMW
<i>Phoxinus eos</i>	Northern redbelly dace	NRBD
<i>Phoxinus erythrogaster</i>	Southern redbelly dace	SRBD
<i>Phoxinus neogaeus</i>	Finescale dace	FSDC
<i>Pimephales notatus</i>	Bluntnose minnow	BNMW
<i>Pimephales promelas</i>	Fathead minnow	FHMW
<i>Pimephales vigilax</i>	Bullhead minnow	BHMW
<i>Platygobio gracilis</i>	Flathead chub	FHCB
<i>P. gracilis</i> X <i>M. meeki</i>	Flathead-sicklefin chub hybrid	FCSC
<i>Rhinichthys atratulus</i>	Blacknose dace	BNDC
<i>Rhinichthys cataractae</i>	Longnose dace	LNDC
<i>Richardsonius balteatus</i>	Redside shiner	RDSS
<i>Scardinius erythrophthalmus</i>	Rudd	RUDD
<i>Semotilus atromaculatus</i>	Creek chub	CKCB
	Unidentified Cyprinidae	UCY
	Unidentified Asian Carp	UAC
Catostomidae - suckers		
<i>Carpionodes carpio</i>	River carpsucker	RVCS
<i>Carpionodes cyprinus</i>	Quillback	QLBK
<i>Carpionodes velifer</i>	Highfin carpsucker	HFCS
<i>Carpionodes</i> spp.	Unidentified Carpiodes	UCS
<i>Catostomus catostomus</i>	Longnose sucker	LNSK
<i>Catostomus commersoni</i>	White sucker	WTSK
<i>Catostomus platyrhynchus</i>	Mountain sucker	MTSK
<i>Catostomus</i> spp.	Unidentified <i>Catostomus</i> spp.	UCA
<i>Cycleptus elongatus</i>	Blue sucker	BUSK*
<i>Hypentelium nigricans</i>	Northern hog sucker	NHSC
<i>Ictiobus bubalus</i>	Smallmouth buffalo	SMBF
<i>Ictiobus cyprinellus</i>	Bigmouth buffalo	BMBF
<i>Ictiobus niger</i>	Black buffalo	BKBF
<i>Ictiobus</i> spp.	Unidentified buffalo	UBF
<i>Minytrema melanops</i>	Spotted sucker	SPSK
<i>Moxostoma anisurum</i>	Silver redhorse	SVRH
<i>Moxostoma carinatum</i>	River redhorse	RVRH
<i>Moxostoma duquesnei</i>	Black redhorse	BKRH
<i>Moxostoma erythrurum</i>	Golden redhorse	GDRH
<i>Moxostoma macrolepidotum</i>	Shorthead redhorse	SHRH
<i>Moxostoma</i> spp.	Unidentified redhorse	URH

Appendix A. (continued).

Scientific name	Common name	Letter Code
Catostomidae - suckers	Unidentified Catostomidae	UCT
ORDER SILURIFORMES		
Ictaluridae – bullhead catfishes		
<i>Ameiurus melas</i>	Black bullhead	BKBH
<i>Ameiurus natalis</i>	Yellow bullhead	YLBH
<i>Ameiurus nebulosus</i>	Brown bullhead	BRBH
<i>Ameiurus</i> spp.	Unidentified bullhead	UBH
<i>Ictalurus furcatus</i>	Blue catfish	BLCF
<i>Ictalurus punctatus</i>	Channel catfish	CNCF
<i>I. furcatus</i> X <i>I. punctatus</i>	Blue-channel catfish hybrid	BCCC
<i>Ictalurus</i> spp.	Unidentified <i>Ictalurus</i> spp.	UCF
<i>Noturus exilis</i>	Slender madtom	SDMT
<i>Noturus flavus</i>	Stonecat	STCT
<i>Noturus gyrinus</i>	Tadpole madtom	TPMT
<i>Noturus nocturnus</i>	Freckled madtom	FKMT
<i>Pylodictis olivaris</i>	Flathead catfish	FHCF
ORDER SALMONIFORMES		
Esocidae - pikes		
<i>Esox americanus vermiculatus</i>	Grass pickerel	GSPK
<i>Esox lucius</i>	Northern pike	NTPK
<i>Esox masquinongy</i>	Muskellunge	MSKG
<i>E. lucius</i> X <i>E. masquinongy</i>	Tiger Muskellunge	TGMG
Umbridae - mudminnows		
<i>Umbra limi</i>	Central mudminnow	MDMN
Osmeridae - smelts		
<i>Osmerus mordax</i>	Rainbow smelt	RBST
Salmonidae - trouts		
<i>Coregonus artedii</i>	Lake herring or cisco	CSCO
<i>Coregonus clupeaformis</i>	Lake whitefish	LKWF
<i>Oncorhynchus aguabonita</i>	Golden trout	GDTT
<i>Oncorhynchus clarki</i>	Cutthroat trout	CTTT
<i>Oncorhynchus kisutch</i>	Coho salmon	CHSM
<i>Oncorhynchus mykiss</i>	Rainbow trout	RBTT
<i>Oncorhynchus nerka</i>	Sockeye salmon	SESM
<i>Oncorhynchus tshawytscha</i>	Chinook salmon	CNSM
<i>Prosopium cylindraceum</i>	Bonneville cisco	BVSC
<i>Prosopium williamsoni</i>	Mountain whitefish	MTWF
<i>Salmo trutta</i>	Brown trout	BNTT
<i>Salvelinus fontinalis</i>	Brook trout	BKTT
<i>Salvelinus namaycush</i>	Lake trout	LKTT
<i>Thymallus arcticus</i>	Arctic grayling	AMGL

Appendix A. (continued).

Scientific name	Common name	Letter Code
	ORDER PERCOPSIFORMES	
	Percopsidae – trout-perches	
<i>Percopsis omiscomaycus</i>	Trout-perch	TTPH
	ORDER GADIFORMES	
	Gadidae - cods	
<i>Lota lota</i>	Burbot	BRBT
	ORDER ATHERINIFORMES	
	Cyprinodontidae - killifishes	
<i>Fundulus catenatus</i>	Northern studfish	NTSF
<i>Fundulus diaphanus</i>	Banded killifish	BDKF
<i>Fundulus notatus</i>	Blackstripe topminnow	BSTM
<i>Fundulus olivaceus</i>	Blackspotted topminnow	BPTM
<i>Fundulus sciadicus</i>	Plains topminnow	PTMW
<i>Fundulus zebrinus</i>	Plains killifish	PKLF
	Poeciliidae - livebearers	
<i>Gambusia affinis</i>	Western mosquitofish	MQTF
	Atherinidae - silversides	
<i>Labidesthes sicculus</i>	Brook silverside	BKSS
	ORDER GASTEROSTEIFORMES	
	Gasterosteidae - sticklebacks	
<i>Culaea inconstans</i>	Brook stickleback	BKSB
	ORDER SCORPAENIFORMES	
	Cottidae - sculpins	
<i>Cottus bairdi</i>	Mottled sculpin	MDSP
<i>Cottus caroliniae</i>	Banded sculpin	BDSP
	ORDER PERCIFORMES	
	Percichthyidae – temperate basses	
<i>Morone Americana</i>	White perch	WTPH
<i>Morone chrysops</i>	White bass	WTBS
<i>Morone mississippiensis</i>	Yellow bass	YWBS
<i>Morone saxatilis</i>	Striped bass	SDBS
<i>M. saxatilis X M. chrysops</i>	Striped-white bass hybrid	SBWB
	Centrarchidae - sunfishes	
<i>Ambloplites rupestris</i>	Rock bass	RKBS
<i>Archoplites interruptus</i>	Sacramento perch	SOPH
<i>Lepomis cyanellus</i>	Green sunfish	GNSF
<i>Lepomis gibbosus</i>	Pumpkinseed	PNSD
<i>Lepomis gulosus</i>	Warmouth	WRMH
<i>Lepomis humilis</i>	Orangespotted sunfish	OSSF
<i>Lepomis macrochirus</i>	Bluegill	BLGL
<i>Lepomis magalotis</i>	Longear sunfish	LESF
<i>Lepomis microlophus</i>	Redear sunfish	RESF
<i>L. cyanellus X L. macrochirus</i>	Green sunfish-bluegill hybrid	GSBG

Appendix A. (continued).

Scientific name	Common name	Letter Code
Centrarchidae - sunfishes		
<i>L. cyanellus</i> X <i>L. humilis</i>	Green-orangespotted sunfish hybrid	GSOS
<i>L. macrochirus</i> X <i>L. microlophus</i>	Bluegill-redear sunfish hybrid	BGRE
<i>Lepomis</i> spp.	Unidentified <i>Lepomis</i>	ULP
<i>Micropterus dolomieu</i>	Smallmouth bass	SMBS
<i>Micropterus punctulatus</i>	Spotted sunfish	STBS
<i>Micropterus salmoides</i>	Largemouth bass	LMBS
<i>Micropterus</i> spp.	Unidentified <i>Micropterus</i> spp.	UMC
<i>Pomoxis annularis</i>	White crappie	WTCP
<i>Pomoxis nigromaculatus</i>	Black crappie	BKCP
<i>Pomoxis</i> spp.	Unidentified crappie	UCP
<i>P. annularis</i> X <i>P. nigromaculatus</i>	White-black crappie hybrid	WCBC
Centrarchidae	Unidentified centrarchid	UCN
Percidae - perches		
<i>Ammocrypta asprella</i>	Crystal darter	CLDR
<i>Etheostoma blennioides</i>	Greenside darter	GSDR
<i>Etheostoma caeruleum</i>	Rainbow darter	RBDR
<i>Etheostoma exile</i>	Iowa darter	IODR
<i>Etheostoma flabellare</i>	Fantail darter	FTDR
<i>Etheostoma gracile</i>	Slough darter	SLDR
<i>Etheostoma microperca</i>	Least darter	LTDR
<i>Etheostoma nigrum</i>	Johnny darter	JYDR
<i>Etheostoma punctulatum</i>	Stippled darter	STPD
<i>Etheostoma spectabile</i>	Orangethroated darter	OTDR
<i>Etheostoma tetrazonum</i>	Missouri saddled darter	MSDR
<i>Etheostoma zonale</i>	Banded darter	BDDR
<i>Etheostoma</i> spp.	Unidentified <i>Etheostoma</i> spp.	UET
<i>Perca flavescens</i>	Yellow perch	YWPH
<i>Percina caprodes</i>	Logperch	LGPH
<i>Percina cymatotaenia</i>	Bluestripe darter	BTDR
<i>Percina evides</i>	Gilt darter	GLDR
<i>Percina maculata</i>	Blackside darter	BSDR
<i>Percina phoxocephala</i>	Slenderhead darter	SHDR
<i>Percina shumardi</i>	River darter	RRDR
<i>Percina</i> spp.	Unidentified <i>Percina</i> spp.	UPN
	Unidentified darter	UDR
<i>Sander canadense</i>	Sauger	SGER*
<i>Sander vitreus</i>	Walleye	WLEY
<i>S. canadense</i> X <i>S. vitreus</i>	Sauger-walleye hybrid/Saugeye	SGWE
<i>Sander</i> spp.	Unidentified <i>Sander</i> (formerly <i>Stizostedion</i>) spp.	UST
	Unidentified Percidae	UPC
Sciaenidae - drums		
<i>Aplodinotus grunniens</i>	Freshwater drum	FWDM
NON-TAXONOMIC CATEGORIES		
	Age-0/Young-of-year fish	YOYF
	Lab fish for identification	LAB
	No fish caught	NFSH
	Unidentified larval fish	LVFS
	Unidentified	UNID
	Net Malfunction (Did Not Fish)	NDNF

Appendix B. Definitions and codes used to classify standard Missouri River habitats in the long-term pallid sturgeon and associated fish community sampling program. Three habitat scales were used in the hierarchical habitat classification system: Macrohabitats, Mesohabitats, and Microhabitats.

Habitat	Scale	Definition	Code
Braided channel	Macro	An area of the river that contains multiple smaller channels and is lacking a readily identifiable main channel (typically associated with unchannelized sections)	BRAD
Main channel cross over	Macro	The inflection point of the thalweg where the thalweg crosses from one concave side of the river to the other concave side of the river, (i.e., transition zone from one-bend to the next bend). The upstream CHXO for a respective bend is the one sampled.	CHXO
Tributary confluence	Macro	Area immediately downstream, extending up to one bend in length, from a junction of a large tributary and the main river where this tributary has influence on the physical features of the main river	CONF
Dendritic	Macro	An area of the river where the river transitions from meandering or braided channel to more of a treelike pattern with multiple channels (typically associated with unchannelized sections)	DEND
Deranged	Macro	An area of the river where the river transitions from a series of multiple channels into a meandering or braided channel (typically associated with unchannelized sections)	DRNG
Main channel inside bend	Macro	The convex side of a river bend	ISB
Main channel outside bend	Macro	The concave side of a river bend	OSB
Secondary channel-connected large	Macro	A side channel, open on upstream and downstream ends, with less flow than the main channel, large indicates this habitat can be sampled with trammel nets and trawls based on width and/or depths > 1.2 m	SCCL
Secondary channel-connected small	Macro	A side channel, open on upstream and downstream ends, with less flow than the main channel, small indicates this habitat cannot be sampled with trammel nets and trawls based on width and/or on depths < 1.2 m	SCCS
Secondary channel-non-connected	Macro	A side channel that is blocked at one end	SCCN
Tributary	Macro	Any river or stream flowing in the Missouri River	TRIB
Tributary large mouth	Macro	Mouth of entering tributary whose mean annual discharge is > 20 m ³ /s, and the sample area extends 300 m into the tributary	TRML
Tributary small mouth	Macro	Mouth of entering tributary whose mean annual discharge is < 20 m ³ /s, mouth width is > 6 m wide and the sample area extends 300 m into the tributary	TRMS
Wild	Macro	All habitats not covered in the previous habitat descriptions	WILD
Bars	Meso	Sandbar or shallow bank-line areas with depth < 1.2 m	BARS
Pools	Meso	Areas immediately downstream from sandbars, dikes, snags, or other obstructions with a formed scour hole > 1.2 m	POOL
Channel border	Meso	Area in the channelized river between the toe and the thalweg, area in the unchannelized river between the toe and the maximum depth	CHNB
Thalweg	Meso	Main channel between the channel borders conveying the majority of the flow	TLWG
Island tip	Meso	Area immediately downstream of a bar or island where two channels converge with water depths > 1.2 m	ITIP

Appendix C. List of standard and wild gears (type), their corresponding codes in the database, seasons deployed (Fall-Spring, Summer, or all), years used, and catch-per-unit-effort units for collection of Missouri River fishes in segment 9 for the long-term pallid sturgeon and associated fish community sampling program. Long-term monitoring began in 2003 for segment 9.

Gear	Code	Type	Season	Years	CPUE units
Trammel net – 1 inch inner mesh	TN	Standard	All	2003 - Present	fish/100 m drift
Trammel net – 2.5 inch inner mesh	TN25	Standard	Sturgeon	2005 - Present	fish/100 m drift
Gillnet – 4 meshes, small mesh set upstream	GN14	Standard	Sturgeon	2003 - Present	fish/net night
Gillnet – 4 meshes, large mesh set upstream	GN41	Standard	Sturgeon	2003 - Present	fish/net night
Gillnet – 8 meshes, small mesh set upstream	GN18	Standard	Sturgeon	2003 - Present	fish/net night
Gillnet – 8 meshes, large mesh set upstream	GN81	Standard	Sturgeon	2003 - Present	fish/net night
Otter trawl – 16 ft head rope	OT16	Standard	All	2003 - Present	fish/100 m trawled
Otter trawl – 16 ft SKT 4mm x 4mm HB2 MOR	OT01	Wild	Fish Comm.	2006	fish/100 m trawled
Beam trawl	BT	Standard	All	2003 - 2004	fish/100 m trawled
Bag Seine – quarter arc method pulled upstream	BSQU	Wild	Fish Comm.	2003 - 2005	fish/100 m ²
Bag Seine – quarter arc method pulled downstream	BSQD	Wild	Fish Comm.	2003 - 2005	fish/100 m ²
Bag Seine – half arc method pulled upstream	BSHU	Wild	Fish Comm.	2003 - 2005	fish/100 m ²
Bag Seine – half arc method pulled downstream	BSHD	Wild	Fish Comm.	2003 - 2005	fish/100 m ²
Bag seine – rectangular method pulled upstream	BSRU	Wild	Fish Comm.	2003 - 2005	fish/100 m ²
Bag seine – rectangular method pulled upstream	BSRD	Wild	Fish Comm.	2003 - 2005	fish/100 m ²
Mini-fyke net	MF	Standard	Fish Comm.	2003 - Present	fish/net night

Appendix D. Stocking locations and codes for pallid sturgeon by Recovery Priority Management Area (RPMA) in the Missouri River Basin.

State(s)	RPMA	Site Name	Code	River	R.M.
MT	2	Above Intake	AIN	Yellowstone	70 +
MT	2	Intake	INT	Yellowstone	70.0
MT	2	Sidney	SID	Yellowstone	31.0
MT	2	Big Sky Bend	BSB	Yellowstone	17.0
ND	2	Fairview	FRV	Yellowstone	9.0
MT	2	Milk River	MLK	Milk	11.5
MT	2	Mouth of Milk	MOM	Missouri	1761.5
MT	2	Wolf Point	WFP	Missouri	1701.5
MT	2	Poplar	POP	Missouri	1649.5
MT	2	Brockton	BRK	Missouri	1678.0
MT	2	Culbertson	CBS	Missouri	1621.0
MT	2	Nohly Bridge	NOB	Missouri	1590.0
ND	2	Confluence	CON	Missouri	1581.5
SD/NE	3	Sunshine Bottom	SUN	Missouri	866.2
SD/NE	3	Verdel Boat Ramp	VER	Missouri	855.0
SD/NE	3	Standing Bear Bridge	STB	Missouri	845.0
SD/NE	3	Running Water	RNW	Missouri	840.1
SD/NE	4	St. Helena	STH	Missouri	799.0
SD/NE	4	Mullberry Bend	MUL	Missouri	775.0
NE/IA	4	Ponca State Park	PSP	Missouri	753.0
NE/IA	4	Sioux City	SIO	Missouri	732.6
NE/IA	4	Decatur	DCT	Missouri	691.0
NE/IA	4	Boyer Chute	BYC	Missouri	637.4
NE/IA	4	Bellevue	BEL	Missouri	601.4
NE/IA	4	Rulo	RLO	Missouri	497.9
NE/MO/KS	4	Kansas River	KSR	Missouri	367.5
NE	4	Platte River	PLR	Platte	5.0
KA/MO	4	Leavenworth	LVW	Missouri	397.0
MO	4	Parkville	PKV	Missouri	377.5
MO	4	Kansas City	KAC	Missouri	342.0
MO	4	Miami	MIA	Missouri	262.8
MO	4	Grand River	GDR	Missouri	250.0
MO	4	Boonville	BOO	Missouri	195.1
MO	4	Overton	OVT	Missouri	185.1
MO	4	Hartsburg	HAR	Missouri	160.0
MO	4	Jefferson City	JEF	Missouri	143.9
MO	4	Mokane	MOK	Missouri	124.7
MO	4	Hermann	HER	Missouri	97.6
MO	4	Washington	WAS	Missouri	68.5
MO	4	St. Charles	STC	Missouri	28.5

Appendix E. Juvenile and adult pallid sturgeon stocking summary for segment 9 of the Missouri River (RPMA 4)

Year	Stocking Site	Number Stocked	Year Class	Stock Date	Age at Stocking^a	Primary Mark	Secondary Mark
1997	Platte River	402	1997	10/15/1997	Fingerling	Floy	CWT
1998	Two Rivers Rec. Area	84	1992	4/17/1998	6 yr Old	PIT Tag	CWT
1999	Two Rivers Rec. Area	15	1992	5/17/1999	7 yr Old	PIT Tag	CWT
2004	Leavenworth	38	2003	7/8/2004	Yearling	Elastomer	CWT
2004	Leavenworth	787	2003	7/8/2004	Yearling	PIT Tag	Elastomer
2004	Leavenworth	944	2003	7/30/2004	Yearling	PIT Tag	Elastomer
2004	Leavenworth	9170	2004	9/10/2004	Yearling	Elastomer	CWT
2004	Leavenworth	2864	2004	10/8/2004	Yearling	Elastomer	CWT
2006	Rulo	626	2005	5/5/2006	Yearling	PIT Tag	Elastomer
2006	Parkville	427	2005	8/31/2006	Yearling	PIT Tag	Elastomer

Appendix F

Total catch, overall mean catch per unit effort (± 2 SE), and mean CPUE (fish/100 m) by Mesohabitat within a Macrohabitat for all species caught with each gear type during sturgeon season and fish community season for segment 9 of the Missouri River during 2006. Species captured are listed alphabetically and their codes are presented in Appendix A. Asterisks with bold type indicate targeted native Missouri River species and habitat abbreviations are presented in Appendix B. Standard Error was not calculated when $N < 2$.

Appendix F1. Gill net: overall season and segment summary. Lists CPUE (fish/net night) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		SCCS	TRML
			CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	POOL	ITIP	TLWG
BHCP	7	0.012 (0.009)	0.030 (0.044)	0.033 (0.046)			0.003 (0.007)							
BLCF	69	0.163 (0.070)	0.250 (0.259)	0.100 (0.169)			0.169 (0.098)	0.097 (0.098)		0.786 (1.110)				
BLGL	1	0.001 (0.003)					0.003 (0.007)							
BUSK	97	0.175 (0.058)	0.160 (0.123)	0.150 (0.204)			0.169 (0.088)	0.159 (0.096)		0.357 (0.360)	0.250 (0.500)	1.333 (2.667)		
CARP	28	0.061 (0.027)	0.010 (0.020)	0.017 (0.033)		0.500 (0.000)	0.052 (0.034)	0.102 (0.078)		0.214 (0.297)		0.167 (0.333)		
CNCF	117	0.274 (0.197)	0.130 (0.166)	0.167 (0.121)		0.250 (0.500)	0.138 (0.089)	0.665 (0.716)				0.167 (0.333)		
FHCF	10	0.016 (0.012)	0.030 (0.044)			0.500 (1.000)	0.003 (0.007)	0.023 (0.022)				0.167 (0.333)		
FWDM	20	0.051 (0.037)	0.040 (0.056)	0.117 (0.149)		0.500 (1.000)	0.017 (0.021)	0.085 (0.118)		0.071 (0.143)				
GDEY	639	1.367 (0.393)	1.320 (0.838)	1.600 (1.279)		4.000 (7.000)	1.234 (0.710)	1.358 (0.532)	1.500 (1.732)	2.857 (4.087)		2.000 (3.055)		
GSCP	16	0.031 (0.019)	0.010 (0.020)	0.050 (0.074)			0.021 (0.019)	0.057 (0.057)		0.071 (0.143)				
GZSD	37	0.080 (0.039)	0.100 (0.099)	0.100 (0.139)		0.250 (0.500)	0.072 (0.066)	0.074 (0.064)		0.143 (0.286)				
LKSG	4	0.007 (0.008)					0.003 (0.007)	0.023 (0.028)						
LNGR	175	0.297 (0.174)	0.390 (0.590)	0.217 (0.338)			0.107 (0.063)	0.648 (0.536)						
NTPK	1	0.001 (0.003)						0.006 (0.011)						
PDFH	9	0.016 (0.012)	0.020 (0.028)	0.017 (0.033)			0.014 (0.017)	0.011 (0.016)		0.143 (0.286)				
PDSG	15	0.024 (0.013)	0.040 (0.048)	0.017 (0.033)		0.250 (0.500)	0.007 (0.010)	0.045 (0.035)						
RVCS	37	0.083 (0.037)	0.080 (0.096)	0.033 (0.067)		1.250 (2.500)	0.021 (0.022)	0.182 (0.102)		0.143 (0.286)				
SGER	92	0.178 (0.053)	0.180 (0.120)	0.233 (0.178)		2.000 (4.000)	0.103 (0.071)	0.267 (0.094)		0.071 (0.143)				

Appendix F1 (continued).

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		SCCS	TRML
			CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	POOL	ITIP	TLWG
SHRH	5	0.009 (0.008)	0.020 (0.040)	0.017 (0.033)			0.010 (0.012)							
SJHR	1	0.001 (0.003)						0.006 (0.011)						
SMBF	52	0.126 (0.072)	0.060 (0.068)	0.133 (0.267)			0.014 (0.017)	0.364 (0.244)		0.143 (0.286)				
SNGR	174	0.321 (0.168)	0.490 (0.571)	0.500 (0.608)			0.086 (0.064)	0.557 (0.476)		0.786 (1.412)				
SNPD	12	0.021 (0.023)					0.014 (0.017)	0.057 (0.083)						
SNSG	1934	3.439 (0.649)	3.070 (2.143)	4.517 (1.789)		11.250 (21.500)	2.117 (0.638)	4.636 (1.394)	9.250 (9.912)	4.357 (6.951)	3.250 (2.500)	12.667 (10.398)		
SVCP	8	0.015 (0.012)	0.020 (0.040)				0.007 (0.010)	0.034 (0.035)						
URH	1	0.003 (0.006)					0.007 (0.014)							
WLYE	4	0.007 (0.008)					0.007 (0.014)	0.017 (0.019)						
WTBS	2	0.003 (0.004)		0.017 (0.033)				0.006 (0.011)						
WTSK	1	0.001 (0.003)								0.071 (0.143)				

Appendix F2. 1 inch trammel net: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		SCCS	TRML
			CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	ITIP	ITIP	TLWG
BHCP	19	0.038 (0.019)	0.046 (0.045)		0.486 (0.427)		0.024 (0.018)							
BLCF	12	0.023 (0.017)					0.034 (0.024)							
BMBF	5	0.011 (0.010)	0.012 (0.025)		0.246 (0.263)		0.004 (0.008)							
BUSK	303	0.704 (0.178)	0.226 (0.142)		0.045 (0.091)		0.926 (0.251)				0.249 (0.210)			
CARP	16	0.027 (0.030)			0.175 (0.266)		0.025 (0.042)				0.085 (0.084)			
CNCF	37	0.074 (0.035)	0.061 (0.064)		0.225 (0.362)		0.048 (0.033)				0.330 (0.282)			
FHCF	5	0.010 (0.010)					0.014 (0.014)				0.010 (0.020)			
FWDM	7	0.009 (0.009)			0.091 (0.182)		0.008 (0.010)				0.028 (0.040)			
GDEY	80	0.174 (0.048)	0.157 (0.113)		0.091 (0.182)		0.176 (0.058)				0.244 (0.150)			
GSCP	6	0.011 (0.010)	0.005 (0.010)				0.012 (0.012)				0.030 (0.061)			
GZSD	22	0.031 (0.017)			0.145 (0.291)		0.024 (0.018)				0.168 (0.123)			
LKSG	1	0.001 (0.003)					0.002 (0.004)							
LNGR	23	0.049 (0.026)	0.059 (0.078)				0.044 (0.026)				0.093 (0.093)			
PDSG	11	0.021 (0.014)			0.065 (0.130)		0.027 (0.019)				0.020 (0.028)			
QLBK	1	0.002 (0.005)					0.004 (0.008)							
RVCS	10	0.027 (0.020)	0.030 (0.043)		0.090 (0.180)		0.027 (0.025)							
SGER	10	0.019 (0.013)					0.027 (0.019)				0.020 (0.028)			
SGWE	1	0.002 (0.006)					0.004 (0.008)							

Appendix F2 (continued).

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		SCCS	TRML
			CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	ITIP	ITIP	TLWG
SHRH	2	0.001 (0.008)	0.013 (0.026)				0.004 (0.008)							
SJHR	2	0.003 (0.006)					0.004 (0.008)				0.010 (0.020)			
SMBF	41	0.077 (0.026)	0.099 (0.065)		0.297 (0.353)		0.068 (0.028)				0.029 (0.033)			
SNGR	6	0.013 (0.012)					0.009 (0.011)				0.105 (0.118)			
SNSG	890	1.520 (0.332)	0.588 (0.515)		4.097 (2.973)		1.120 (0.284)				7.419 (2.481)			
SVCP	3	0.007 (0.008)	0.012 (0.025)				0.006 (0.009)							
WLYE	3	0.003 (0.005)			0.136 (0.183)						0.010 (0.020)			

Appendix F3. 2.5 inch trammel net: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		SCCS	TRML
			CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	ITIP	ITIP	TLWG
BHCP	7	0.036 (0.027)	0.070 (0.080)				0.027 (0.027)							
BKBF	1	0.004 (0.010)					0.007 (0.014)							
BLCF	2	0.008 (0.013)	0.020 (0.040)				0.006 (0.011)							
BMBF	5	0.022 (0.021)	0.016 (0.031)				0.027 (0.027)							
BUSK	130	0.672 (0.197)	0.314 (0.195)		0.872 (0.382)		0.781 (0.260)				0.982 (1.525)			
CARP	5	0.027 (0.025)	0.049 (0.068)				0.022 (0.026)							
FHCF	1	0.004 (0.010)					0.007 (0.014)							
FWDM	2	0.012 (0.018)	0.025 (0.049)				0.009 (0.018)							
GDEY	1	0.006 (0.013)					0.009 (0.018)							
GSCP	12	0.053 (0.032)	0.045 (0.066)				0.059 (0.039)							
GZSD	2	0.012 (0.017)	0.050 (0.070)											
PDFH	2	0.009 (0.014)			0.337 (0.673)		0.007 (0.013)							
RVCS	12	0.070 (0.043)	0.085 (0.086)				0.055 (0.045)				0.400 (0.800)			
SMBF	27	0.124 (0.052)	0.080 (0.081)				0.146 (0.067)							
SNGR	1	0.006 (0.013)	0.026 (0.052)											
SNSG	64	0.352 (0.147)	0.305 (0.240)		1.044 (1.168)		0.326 (0.176)				1.175 (1.791)			

Appendix F4. Otter trawl: overall season and segment summary. Lists CPUE (fish/100 m) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		SCCS	TRML
			CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	ITIP	ITIP	CHNB
BHCP	1	0.002 (0.005)					0.004 (0.008)							
BHMW	1	0.002 (0.004)					0.003 (0.006)							
BLCF	296	0.400 (0.199)	0.227 (0.145)		0.317 (0.635)		0.501 (0.301)		1.485 (2.970)		0.016 (0.032)			0.427 (0.855)
BLGL	6	0.007 (0.008)	0.009 (0.017)				0.003 (0.005)				0.047 (0.072)			
BUSK	87	0.177 (0.058)	0.137 (0.111)		0.385 (0.399)		0.192 (0.079)				0.180 (0.124)			0.037 (0.074)
CARP	14	0.024 (0.018)	0.035 (0.042)				0.013 (0.014)		1.212 (2.424)		0.027 (0.039)			
CNCF	1294	2.207 (0.445)	2.283 (1.028)		1.850 (2.247)		1.977 (0.509)		4.788 (2.304)		2.130 (1.128)			8.245 (5.935)
ERSN	416	0.869 (0.555)	0.081 (0.071)				1.062 (0.779)				2.193 (3.068)			
FHCF	31	0.061 (0.036)	0.092 (0.101)		0.132 (0.265)		0.052 (0.040)				0.051 (0.062)			
FWDM	1407	2.531 (1.273)	3.096 (2.473)		6.690 (8.395)		1.568 (1.317)		2.697 (0.546)		1.973 (2.151)			23.839 (31.450)
GDEY	14	0.016 (0.013)	0.008 (0.015)				0.024 (0.020)				0.011 (0.022)			
GNSF	1	0.002 (0.005)					0.004 (0.007)							
GZSD	33	0.030 (0.044)					0.009 (0.011)				0.302 (0.580)			0.037 (0.074)
LNGR	2	0.002 (0.004)			0.066 (0.132)		0.003 (0.005)							
MNEY	2	0.002 (0.005)					0.004 (0.008)							
OSSF	2	0.002 (0.004)					0.003 (0.006)				0.011 (0.023)			
PDFH	1	0.002 (0.006)					0.004 (0.009)							
PDSG	4	0.007 (0.007)	0.011 (0.023)				0.002 (0.004)				0.018 (0.037)			0.084 (0.168)

Appendix F4 (continued).

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		SCCS	TRML
			CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	ITIP	ITIP	CHNB
PNMW	1	0.001									0.011			
		(0.002)									(0.022)			
QLBK	1	0.001					0.002							
		(0.003)					(0.005)							
RDSN	74	0.123					0.128				0.225			1.113
		(0.090)					(0.127)				(0.160)			(1.522)
RVCS	70	0.139	0.066		0.368		0.154		0.303		0.191			0.156
		(0.081)	(0.060)		(0.573)		(0.121)		(0.606)		(0.160)			(0.164)
RVSN	353	0.539	0.059		0.224		0.478				1.193			5.711
		(0.394)	(0.064)		(0.305)		(0.480)				(1.326)			(10.170)
SFCB	166	0.254	0.306		0.079		0.277		0.495		0.011			
		(0.084)	(0.196)		(0.159)		(0.108)		(0.990)		(0.022)			
SFSN	6	0.254					0.015				0.029			
		(0.084)					(0.019)				(0.041)			
SGCB	113	0.165	0.105				0.192				0.203			
		(0.054)	(0.067)				(0.077)				(0.179)			
SGER	22	0.043	0.032				0.043				0.092			0.084
		(0.022)	(0.037)				(0.028)				(0.107)			(0.168)
SGWE	1	0.003					0.005							
		(0.006)					(0.010)							
SHRH	4	0.006					0.007				0.023			
		(0.008)					(0.011)				(0.045)			
SJHR	4	0.010	0.010				0.012							
		(0.012)	(0.020)				(0.018)							
SKCB	346	0.573	0.276		0.253		0.659				0.975			0.222
		(0.181)	(0.148)		(0.366)		(0.247)				(1.017)			(0.314)
SMBF	6	0.006	0.009				0.001				0.045			
		(0.007)	(0.018)				(0.002)				(0.071)			
SMBS	1	0.002					0.004							
		(0.005)					(0.008)							
SMMW	1	0.001					0.001							
		(0.002)					(0.003)							
SNGR	7	0.013	0.034				0.002				0.056			
		(0.014)	(0.054)				(0.004)				(0.083)			
SNPD	1	0.002					0.003							
		(0.004)					(0.007)							

Appendix F4 (continued).

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		SCCS	TRML
			CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	POOL	CHNB	ITIP	ITIP	TLWG
SNSG	403	0.710	0.739		1.845		0.649		0.990		0.904			0.608
		(0.152)	(0.368)		(2.162)		(0.180)		(1.980)		(0.334)			(0.626)
SNSN	25	0.039	0.021				0.019				0.278			0.098
		(0.033)	(0.042)				(0.019)				(0.386)			(0.196)
STCT	4	0.005					0.002				0.046			
		(0.005)					(0.005)				(0.053)			
SVCB	1311	2.219	0.721		0.335		2.690				1.495			8.949
		(0.730)	(0.353)		(0.433)		(1.022)				(1.059)			(12.600)
UCY	45	0.080	0.203				0.019				0.278			
		(0.106)	(0.400)				(0.038)				(0.555)			
WLYE	4	0.007					0.007				0.018			0.049
		(0.007)					(0.010)				(0.037)			(0.098)
WTBS	50	0.081	0.100		0.519		0.056				0.096			0.240
		(0.045)	(0.126)		(0.738)		(0.045)				(0.097)			(0.325)
WTCP	1	0.001									0.011			
		(0.002)									(0.023)			
YWPH	1	0.001					0.001							
		(0.002)					(0.002)							

Appendix F6. Mini-fyke net: overall season and segment summary. Lists CPUE (fish/net night) and 2 standard errors in brackets.

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		TRMS	TRML
			BARS	POOL	CHNB	POOL	BARS	POOL	BARS	POOL	BARS	ITIP	BARS	BARS
BHMW	13	0.078 (0.090)	0.227 (0.331)				0.033 (0.037)							
BKCP	2	0.012 (0.017)					0.022 (0.031)							
BKSS	11	0.066 (0.060)	0.114 (0.186)				0.033 (0.048)		0.053 (0.105)		0.500 (0.577)			
BLCF	3	0.018 (0.027)					0.033 (0.048)							
BLGL	162	0.975 (0.355)	1.795 (1.046)				0.663 (0.346)		0.368 (0.274)		2.250 (2.872)		0.600 (1.200)	1.500 (3.000)
BMBF	1	0.006 (0.012)	0.023 (0.045)											
BNMW	21	0.126 (0.117)	0.273 (0.418)				0.054 (0.048)		0.211 (0.246)					
CARP	14	0.084 (0.047)	0.068 (0.077)				0.109 (0.072)							0.500 (1.000)
CKCB	11	0.066 (0.060)	0.114 (0.186)				0.043 (0.043)						0.400 (0.800)	
CLSR	14	0.084 (0.058)	0.068 (0.077)				0.065 (0.060)		0.158 (0.316)				0.400 (0.800)	
CNCF	182	1.096 (0.256)	0.545 (0.382)				1.391 (0.367)		1.105 (0.850)		1.500 (1.915)		0.400 (0.490)	0.500 (1.000)
ERSN	8724	52.554 (31.721)	31.818 (24.981)				67.337 (55.210)		53.263 (42.674)		22.750 (10.404)		4.000 (3.347)	3.000 (6.000)
FHCB	5	0.030 (0.060)					0.054 (0.109)							
FHCF	7	0.042 (0.031)					0.065 (0.052)		0.053 (0.105)					
FHMW	61	0.367 (0.244)	0.636 (0.451)				0.315 (0.376)		0.053 (0.105)		0.750 (1.500)			
FWDM	325	1.957 (0.481)	3.023 (1.329)				1.663 (0.528)		1.211 (0.743)		1.000 (1.414)		2.000 (2.608)	1.000 (2.000)
GDEY	2	0.012 (0.024)	0.045 (0.091)											
GNSF	29	0.174 (0.084)	0.205 (0.201)				0.163 (0.094)		0.105 (0.145)				0.600 (1.200)	

Appendix F6 (continued).

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		TRMS	TRML
			BARS	POOL	CHNB	POOL	BARS	POOL	BARS	POOL	BARS	ITIP	BARS	BARS
GSCP	1	0.006 (0.012)					0.011 (0.022)							
GZSD	152	0.915 (0.931)	2.818 (3.451)				0.141 (0.126)		0.211 (0.246)		2.000 (2.828)		0.400 (0.800)	0.500 (1.000)
LMBS	6	0.036 (0.034)	0.023 (0.045)				0.043 (0.053)		0.053 (0.105)					
LNGR	10	0.060 (0.058)	0.114 (0.186)				0.011 (0.022)		0.053 (0.105)				0.400 (0.800)	0.500 (1.000)
LSSR	5	0.030 (0.040)					0.054 (0.072)							
MMSH	2	0.012 (0.017)	0.023 (0.045)										0.200 (0.400)	
MNEY	1	0.006 (0.012)					0.011 (0.022)							
MQTF	79	0.475 (0.500)	1.159 (1.777)				0.239 (0.292)		0.316 (0.376)					
OSSF	184	1.108 (0.358)	1.295 (0.696)				1.283 (0.542)		0.263 (0.258)				0.800 (0.980)	
PNMW	58	0.349 (0.264)	0.227 (0.290)				0.511 (0.453)		0.053 (0.105)					
QLBK	1	0.006 (0.012)									0.250 (0.500)			
RBST	2	0.012 (0.017)	0.045 (0.064)											
RDSN	3553	21.403 (8.757)	30.727 (27.662)				20.870 (8.436)		8.421 (4.902)		8.750 (3.304)		17.200 (26.156)	
RVCS	134	0.807 (0.271)	1.091 (0.721)				0.652 (0.302)		0.684 (0.460)		1.750 (2.872)		1.000 (1.549)	0.500 (1.000)
RVSN	1956	11.783 (7.695)	9.545 (6.110)				15.109 (13.445)		1.842 (2.013)		25.750 (38.266)		0.800 (1.166)	2.000 (0.000)
SFSN	31	0.186 (0.161)	0.023 (0.045)				0.304 (0.285)				0.500 (1.000)			
SGCB	2	0.012 (0.017)	0.023 (0.045)				0.011 (0.022)							
SGER	13	0.078 (0.064)	0.045 (0.064)				0.120 (0.111)							

Appendix F6 (continued).

Species	Total Catch	Overall CPUE	CHXO		CONF		ISB		OSB		SCCL		TRMS	TRML
			CHNB	POOL	CHNB	POOL	BARS	POOL	CHNB	POOL	BARS	ITIP	BARS	BARS
SHRH	1	0.006 (0.012)	0.023 (0.045)											
SJHR	5	0.030 (0.040)	0.091 (0.143)						0.053 (0.105)					
SKCB	2	0.012 (0.017)					0.011 (0.022)				0.250 (0.500)			
SMBF	101	0.608 (0.730)	0.659 (1.052)				0.109 (0.095)				14.250 (27.837)		0.800 (0.980)	0.500 (1.000)
SMMW	15	0.090 (0.076)	0.023 (0.045)				0.065 (0.060)						1.600 (1.960)	
SNGR	81	0.488 (0.130)	0.682 (0.303)				0.370 (0.147)		0.526 (0.442)				1.000 (0.894)	1.000 (0.000)
SNSN	1336	8.048 (3.766)	9.250 (8.632)				8.761 (5.262)		1.105 (1.269)		19.750 (24.985)		4.400 (5.607)	0.500 (1.000)
STBS	1	0.006 (0.012)	0.023 (0.045)											
SVCB	761	4.584 (3.141)	8.659 (11.490)				3.424 (1.269)		0.789 (0.604)		9.750 (11.325)		1.400 (2.332)	2.000 (2.000)
UBF	1	0.006 (0.012)											0.200 (0.400)	
UCN	12	0.072 (0.079)	0.182 (0.278)				0.033 (0.048)						0.200 (0.400)	
UCY	40	0.241 (0.434)	0.864 (1.635)				0.011 (0.022)						0.200 (0.400)	
ULP	1	0.006 (0.012)					0.011 (0.022)							
WLYE	2	0.012 (0.017)					0.022 (0.031)							
WTBS	386	2.325 (0.951)	3.932 (3.061)				1.685 (0.696)		1.842 (2.301)		0.750 (1.500)		3.800 (4.445)	0.500 (1.000)
WTCP	35	0.210 (0.138)	0.432 (0.466)				0.076 (0.064)		0.053 (0.105)		1.000 (1.414)		0.200 (0.400)	1.500 (1.000)

Appendix G. Hatchery names, locations and abbreviations.

Hatchery	State	Abbreviation
Blind Pony State Fish Hatchery	MO	BYP
Neosho National Fish Hatchery	MO	NEO
Gavins Point National Fish Hatchery	SD	GAV
Garrison Dam National Fish Hatchery	ND	GAR
Miles City State Fish Hatchery	MT	MCH
Blue Water State Fish Hatchery	MT	BLU
Bozeman Fish Technology Center	MT	BFT
Fort Peck State Fish Hatchery	MT	FPH

Appendix H. Alphabetic list of Missouri River fishes with total catch-per-unit-effort by gear type for sturgeon season (fall through spring) and fish community season (summer) during 2006 for segment 9 of the Missouri River. Species codes are located in Appendix A. Asterisks and bold type denote targeted native Missouri River species.

Species Code	Sturgeon Season (Fall through Spring)				Fish Community Season (Summer)		
	1 Inch Trammel Net	2.5 Inch Trammel Net	Gill Net	Otter Trawl	1 Inch Trammel Net	Mini-Fyke Net	Otter Trawl
BHCP	0.041	0.036	0.012		0.033		0.004
BHMW				0.004		0.078	
BKBF		0.004					
BKCP						0.012	0.629
BKSS						0.066	
BLCF		0.008	0.163	0.122	0.054	0.018	
BLGL			0.001			0.975	0.013
BMBF	0.011	0.022			0.010	0.006	
BNMW						0.126	
BUSK	0.702	0.672	0.175	0.059	0.706		0.273
CARP	0.021	0.027	0.061	0.052	0.036	0.084	0.001
CKCB						0.066	
CLSR						0.084	
CNCF	0.098		0.274	2.506	0.042	1.096	
ERSN				0.031		52.554	1.560
FHCB						0.030	
FHCF	0.010	0.004	0.016	0.099	0.009	0.042	0.029
FHMW						0.367	
FWDM	0.010	0.012	0.051	1.720	0.008	1.957	
GDEY	0.182	0.006	1.367	0.008	0.163	0.012	0.022
GNSF						0.174	0.004
GSCP	0.013	0.053	0.031		0.009	0.006	
GZSD	0.041	0.012	0.080	0.007	0.019	0.915	0.049
LKSG			0.007		0.003		
LMBS						0.036	
LNGR	0.035		0.297		0.069	0.060	0.005
LSSR						0.030	
MMSH						0.012	
MNEY						0.006	0.005

Appendix H. (continued).

Species Code	Sturgeon Season (Fall through Spring)				Fish Community Season (Summer)		
	1 Inch Trammel Net	2.5 Inch Trammel Net	Gill Net	Otter Trawl	1 Inch Trammel Net	Mini-Fyke Net	Otter Trawl
MQTF						0.475	
NTPK			0.001			1.108	
OSSF				0.004			0.001
PDFH		0.009	0.016	0.006			
PDSG	0.023		0.024	0.015	0.019		
PNMW						0.349	0.001
QLBK	0.004					0.006	0.002
RBST						0.012	
RDSN				0.093		21.403	0.148
RVCS	0.021	0.070	0.083	0.119	0.035	0.807	0.157
RVSN				0.012		11.783	0.715
SFCB				0.354			0.171
SFSN				0.015		0.186	0.008
SGCB				0.039		0.012	0.268
SGER	0.021		0.178	0.059	0.017	0.078	0.031
SGWE	0.005						0.005
SHRH	0.005		0.009	0.003	0.006	0.006	0.008
SJHR	0.001		0.001	0.006	0.006	0.030	0.013
SKCB				0.639		0.012	0.518
SMBF	0.085	0.124	0.126	0.001	0.066	0.608	0.010
SMBS							0.004
SMMW						0.090	0.001
SNGR	0.017	0.006	0.321	0.019	0.008	0.488	0.008
SNPD			0.021				0.004
SNSG	1.756	0.352	3.439	1.069	1.203		0.413
SNSN				0.003		8.048	0.070
STBS						0.006	
STCT				0.011			
SVCB				0.427		4.58	3.696
SVCP	0.012		0.015				

Appendix H. (continued).

Species Code	Sturgeon Season (Fall through Spring)				Fish Community Season (Summer)		
	1 Inch Trammel Net	2.5 Inch Trammel Net	Gill Net	Otter Trawl	1 Inch Trammel Net	Mini-Fyke Net	Otter Trawl
UBF						0.006	
UCN						0.072	
UCY				0.026		0.241	0.125
ULP						0.006	
URH			0.00				
WLYE			0.007	0.008	0.009	0.012	0.005
WTBS			0.003	0.018		2.325	0.132
WTCP						0.210	0.001
WTSK			0.001				
YWPH							0.001

Appendix I. Comprehensive list of bend numbers and bend river miles for segment 9 of the Missouri River comparing bend selection for both sturgeon season (ST) and fish community season (FCS) between years from 2003 - 2006.

Bend Number	Bend River Mile	2003	2004	2005	2006
1	595	ST,FCS	ST,FCS	ST,FCS	ST,FCS
2	591.7	ST		ST,FCS	
3	589			ST	
4	586			ST	ST
5	582.7	ST			
6	578.8	FCS		ST	ST,FCS
7	576.4	FCS	FCS		
8	574.6		ST		
9	572.5				
10	569.8			ST	ST,FCS
11	565			FCS	ST
12	563			ST	
13	559.7				ST
14	557	FCS	ST	ST	
15	554.9	ST,FCS	ST,FCS	ST	ST,FCS
16	553		ST,FCS	ST	
17	550.4				
18	549.6		ST	ST	
19	546.2		ST		
20	544.7		ST		
21	543.3			ST,FCS	
22	542			ST	
23	539.8		FCS	ST	
24	536.9				ST,FCS
25	534.7		ST		ST,FCS
26	533.5		FCS	FCS	ST,FCS
27	531.7			FCS	

Appendix I. (continued).

Bend Number	Bend River Mile	2003	2004	2005	2006
28	529	ST		ST,FCS	
29	526		FCS	ST,FCS	ST,FCS
30	523.9			FCS	ST,FCS
31	522.4			ST, FCS	
32	520.5				
33	518.4				
34	517.6				ST,FCS
35	516	ST	ST,FCS		
36	512.5	FCS		FCS	
37	508.4		ST		
38	506.9			FCS	ST,FCS
39	504.5			ST,FCS	ST,FCS
40	501.8	FCS			
41	500.3			FCS	ST,FCS
42	498.6				ST,FCS
43	494.4				
44	491.2	FCS		ST	
45	489.8				
46	486			FCS	
47	483.4	FCS			
48	480.9		ST		
49	477.7			ST	ST,FCS
50	472.5	ST		FCS	
51	469		FCS	ST	
52	467.1			FCS	
53	463			ST	
54	458.8			FCS	
55	454.9	ST	ST		
56	451.7				
57	449.4		ST,FCS		

Appendix I. (continued).

Bend Number	Bend River Mile	2003	2004	2005	2006
58	443		FCS		
59	438.1	ST		ST	
60	435.2			ST	
61	431.5				
62	429.1				
63	425.3	ST			
64	417.9				
65	415.8				
66	412.2				ST,FCS
67	410				
68	408.4			ST	
69	407	FCS			
70	404.2			ST	ST,FCS
71	400.3			FCS	ST,FCS
72	398.9				
73	397.1			ST	
74	392.4		FCS		ST,FCS
75	388.7				ST,FCS
76	385	ST		FCS	
77	383.2				ST,FCS
78	378.5				ST
79	375.4				
80	371.9			FCS	